I

SUPPLEMENTARY INFORMATION

FOR THE

FINAL ENVIRONMENTAL IMPACT REPORT

MEDICAL AREA TOTAL ENERGY PLANT

BOSTON, MASSACHUSETTS

APRIL 29, 1977

PREPARED FOR
BOSTON REDEVELOPMENT AUTHORITY
AND DEPARTMENT OF ENVIRONMENTAL
QUALITY ENGINEERING

PREPARED BY
UNITED ENGINEERS & CONSTRUCTORS INC.
AND ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

united engineers & constructors inc.

A Raytheon Company

Boston Redevelopment Authority

Robert F. Walsh / Director

City Hall
1 City Hall Square
Boston, Massachusetts 02201
Telephone (617) 722-4300

APR 29 1977

Secretary Evelyn Murphy
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

Dear Secretary Murphy:

RE: Medical Area Total Energy Plant - EOEA No. 01540

Pursuant to your Statement and Memorandum of 24 March 1977 respecting the Final Environmental Impact Report on the Removal of Incineration Service from the proposed Medical Area Total Energy Plant, I am herewith forwarding to you, on behalf of the Department of Environmental Quality Engineering and the Boston Redevelopment Authority, two copies of a Final Environmental Impact Report evaluating all proposed changes to the MATEP facility.

This report is being submitted pursuant to Massachusetts General Laws, Chapter 30, Section 62, and in accordance with the Authority's rules and regulations governing the protection of the environment and in accordance with any other applicable rules and regulations concerning the protection of the environment. By separate cover, copies of this report are being submitted to the Office of the Attorney General, the State Clearinghouse, and the Metropolitan Area Planning Council.

A Final Environmental Impact Report respecting the construction of the MATEP facility was filed with your office on September 29, 1975, and was approved on January 23, 1976. The present report is being filed as a supplement to that report and evaluates changes in impacts from those evaluated in the original EIR as a result of revisions to the plant design.

Sincerely,

Robert F. Walsh
Director

Concurrence:

David Standley, Commissioner
Department of Environmental
Quality Engineering

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PREFACE

This report was prepared for the Boston Redevelopment Authority and and the Department of Environmental Quality Engineering for use in evaluating the environmental impacts of proposed changes to the Medical Area Total Energy Plant. Section 4.0, Removal of Incineration Service, was prepared by Environmental Research & Technology, Inc. The remainder of the report was prepared by United Engineers & Constructors Inc.

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APPENDIX A

COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

ENVIRONMENTAL ASSESSMENT FORM

Please read Environmental Assessment Form Manual before filling out this form.

EOEA File No.

Enter Publication Date:

I. SUMMARY

ACTIVITY FINDING

Negative Assessment
Positive Assessment [1] Enter Code

ACTIVITY IDENTIFICATION

1. Submitting Agency — Executive Office: Environmental Affairs
   Department: Environmental Quality Engineering
   And: Boston Redevelopment Authority (Joint Assessment)
2. Activity Identification: MATEP- 121A AMEND
3. Has this activity been filed with EOEA before? X Yes ___ No
   If so, under what EOEA number? 01540
4. Does this activity fall under jurisdiction of NEPA? ___ Yes X No
   If so, under which federal agency? ___
   Present status? ___

ACTIVITY DESCRIPTION SUMMARY

1. Town, County Region, etc.: City of Boston [035] Enter Code
2. Location within Town or Street Address (if applicable):
   Brookline Avenue - Francis Street
3. Activity Type(s): Energy Generation: Fossil Fuel
4. Agency Involvement: 121A APPLICATION
5. Estimated Commencement: 07 Month 15 Day 77 Year
6. Completion: 06 Month 30 Day 79 Year
7. Estimated Construction Cost: $66,800,000
8. Estimated Operational Cost Per Year: -
9. Summary of Proposal (narrative):

The required action is the approval of Amendments to the 121A Application to the BRA for the Medical Area Total Energy Plant, Inc. The 121A Application was approved December 8, 1975 and the associated Final EIR was approved January 23, 1976. The requested changes include the addition of auxiliary equipment, changes in air quality control equipment, removal of incineration service, and a request for permission to deviate from the Boston Noise Code. A detailed description of the project is included in the attached supplementary information.

COPIES OF THIS ASSESSMENT MAY BE OBTAINED FROM:

Name: Richard Mertens Telephone: ___ Cost Per Copy: ___

Address: Boston Redevelopment Authority, Boston City Hall, Boston, Ma.

II. ACTIVITY DESCRIPTION

A. Include an original 8½ x 11 section of a U.S.G.S. 7½ minute, 1:24,000 scale map with the activity or project area boundaries delineated. (Original U.S.G.S. sheet required for filing with Secretary only; copies may be supplied to others.) Include multiple maps if activity or project is larger than the area delineated on a U.S.G.S. 1:24,000 scale map. Include maps, diagrams or sketches at a larger scale if the features of the activity or project cannot be clearly shown at the 1:24,000 scale.

B. Give a brief description of the present use of the area or areas affected in 5. Indicate the number of acres affected that are:

1. Developed [1 . 7]
2. Open Space [ ]
3. Wetland [ ]
4. Shoreline [ ]

5. The site was originally occupied by residential units (mostly vacant) which have since been demolished. Excavation for the plant foundation is proceeding.

C. Give a brief description of the proposed activity, including all phases and characteristics, in 2.

1. Fill in the following dimensions, if applicable:

a. Total Activity Area (Acres): [1 . 7]
b. Length in Miles: [ ]
c. Number of Housing Units: [ ]
d. Number of Stories: [ ]
e. Number of Parking Spaces: [ ]
f. Vehicular Traffic Generated Per Day: [2 7]

2. The proposed activity reflects refinements in plant components, operation, and dimensions developed since the EIR was approved on January 23, 1976. These are described in the attached supplementary information.

D. Describe how your agency is involved in the activity in 4.
Specify:

1. Permit or Program Type: [1 2 1 A A P P L I C A T I O N]
2. Pertinent Governing Statute(s) or Regulation(s): [C H A P 1 2 1 A M G L]
3. Other State Agencies Involved: [D P T E N V Q U A L E N G]

4. BRA - Approval of Amendments to an Approved Chapter 121A Application

DEQE - Approval of Construction of Total Energy Plant

III. ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACT

Answer the following questions by placing an "X" in the appropriate YES/NO space; consider activity, construction, operational, as well as indirect impacts.

Indicate under "Explanation" why significant impact is considered likely or unlikely to result.

A: OPEN SPACE AND RECREATION

1. Might the activity affect the condition, use or access to any open space and/or recreation area? X NO ____ YES

   If YES, specify area(s) and acreage(s) affected:

(1)
(2)
(3)
(4)
(5)

Acreage Duration Severity Enter Code

2. Explanation:

Open space and recreation areas in the vicinity of the Project Site include the Riverway, Joslin Park, and a neighborhood park on Fenwood Road. The proposed changes will not affect the condition of, nor prevent use of or access to any of these areas.

B. HISTORIC RESOURCES

1. Might any site or structure of historic significance be affected? X NO ____ YES

   If YES, state level of historic significance:

   Significance Duration Severity

2. Might any known archaeologic site be affected by the activity? X NO ____ YES

   If YES, specify duration and severity:

   Duration Severity

3. Might any known paleontologic site be affected by the activity? X NO ____ YES

   If YES, specify duration and severity:

   Duration Severity

4. Explanation:

The Olmsted Park System is the closest area of historic significance to the Project Site and is listed on the National Register of Historic Places. The Project has been reviewed with the State Historic Preservation Officer and a finding of no adverse impact has been made. There are no known archaeological or paleontologic sites in the Project area.

C. ECOLOGICAL EFFECTS

1. Might the activity affect any natural feature adjacent to or near the activity area? X NO ___ YES

   If YES, specify natural features affected:

   (1)
   (2)
   (3)
   (4)
   (5)
   (6)

   Duration Severity Enter C

2. Might the activity affect wildlife or fisheries? X NO ___ YES

   If YES, specify wildlife or fisheries affected:

   (1)
   (2)
   (3)
   (4)

   Duration Severity Enter C

   If YES, specify whether any rare or endangered wildlife or fisheries species might be affected: ___ NO ___ YES

3. Might the activity affect natural vegetation? X NO ___ YES

   If YES, specify vegetation and acreage(s) affected:

   (1)
   (2)
   (3)
   (4)
   (5)
   (6)

   Acreage Duration Severity Enter C

   If YES, specify whether any rare or endangered plant species might be affected: ___ NO ___ YES

4. Explanation:

   The Project Site is located in a built-up urban area with no distinguishing natural features, wildlife, or vegetation.

D. ENVIRONMENTAL HAZARDS

1. Might the activity involve the use, storage, release of, or disposal of potentially hazardous substances? ___ NO X YES

   If YES, specify substance type and rate of usage:

	Substance	Usage Rate	Duration	Severity	Enter
(1)	Fuel Oil Storage(24.4 million gallons/year)		4	3 6	4
(2)					
(3)					

2. Might the activity involve alteration of riverine floodplains, inland wetlands, or coastal wetlands? X NO ___ YES

   If YES, specify duration and severity of impact:

   Duration Severity

3. Might the activity involve construction or other action within geologically unstable areas? X NO ____ YES

4. Explanation:

Oil storage will be underground with no exterior access. Appropriate City and State permits will be obtained to ensure public safety. The Project Site is not located on a wetland or riverplain or in a geologically unstable area. (See also attached supplementary information.)

E. RESOURCE CONSERVATION AND USE

1. Might the activity affect or eliminate land suitable for agricultural or timber production? X NO ____ YES

If YES, specify present agricultural land use and respective acreage(s) affected:

(1)____
(2)____
(3)____

Acreage | Duration | Severity | Enter Code

2. Might the activity affect potential use or extraction of an indispensable or scarce mineral or energy resource? X NO ____ YES

If YES, specify resource affected and approximate amount:

(1)____
(2)____
(3)____

Tons | Duration | Severity | Enter Code

3. Explanation:

The Project Site is not suitable for agricultural or timber production or for extraction of mineral or energy resources.

F. WATER QUALITY AND QUANTITY

1. Might the activity affect the quantity of water resources, within, adjacent to, or near the activity area? X NO ____ YES

If YES, specify water source affected and respective amount (gallons/day):

(1)____
(2)____
(3)____
(4)____

Gallons/Day | Duration | Severity | Enter Code

2. Might the activity result in a deleterious effect on the quality of any water resource areas or watersheds? X NO ____ YES

If YES, specify water resource that might be affected:

(1)____
(2)____
(3)____
(4)____

Duration | Severity | Enter Code

If YES, specify possible substance causing effects:

	Duration	Severity	Enter Co
(1)			
(2)			
(3)			
(4)			

3. Explanation:

The Project Site is not located within or near any water resource area.

G. AIR QUALITY

1. Might the activity affect the air quality in the project area, immediately adjacent areas, or the Air Quality Control Region? ____ NO X YES

If YES, specify possible substances affecting air quality:

	Duration	Severity	Enter C
(1) Particulates	4	2 6	7 0
(2) Sulfur Dioxide	4	2 6	7 0
(3) Nitrogen Oxides	4	2 6	7 0
(4)			
(5)			
(6)			

If YES, specify whether any key receptors may be in the affected area:

	Duration	Severity	Enter C
(1) Hospitals	4	2 6	7 2
(2) Residential Areas	4	2 6	7 2
(3)			

2. Explanation:

The proposed changes will result in a decrease in the particulate and sulfur d oxide emissions described in the EIR approved January 23, 1976, as discussed in the attached supplementary information. Nitrogen oxide emissions for 1990 may increase slightly; however mitigation measures which will be examined, have potential for reducing the emissions below those in the EIR.

H. NOISE

1. Might the activity result in the generation of noise? ____ NO X YES

If YES, specify noise source:

	Duration	Severity	Enter C
(1) Energy Plant Operation	4	2 6	8 0
(2)			
(3)			

2. Explanation:

The proposed changes will result in increased generation of noise. Permission to deviate from the Boston Noise Code will be requested. However, there will be no significant impact resulting from this increase. This is discussed in detail in the attached supplementary information.

I. AESTHETICS

1. Might the activity cause a change in the visual character in or near the activity area? X NO ___ YES

If YES, specify natural and cultural features that may be changed:

(1)
(2)
(3)
(4)
(5)
(6)

Duration Severity Enter Code

2. Explanation:

Although the proposed changes result in an increase in the height dimension of the plant and a decrease from original plans in the amount of pedestrian walkway area on Brookline Avenue, there will be no natural or cultural features affected. (See also attached supplementary information.)

J. PLANNING

1. Will the activity require a variance from or result in a potential violation of any statute ordinance, by law, regulation, or standard, the major purpose of which is to prevent or minimize damage to the environment? ___ NO X YES

If YES, specify variances and/or statues:

Permission is being sought to deviate from the Boston Noise Code

2. Will the activity require certification, authorization, review of plans, or issuance of a permit by any local, state or federal agency? ___ NO X YES

If YES, specify agency and action required:

Dept. of Environmental Quality Engineering -
Air Quality Plans Approval

3. Will the activity comply with all federal, state and local land use, transportation, open space, recreation and conservation plans? ___ NO X YES

If NO, state plan type and specific agency concerned:

(1)
(2)
(3)
(4)

Enter Code

4. Explanation:

Permission to deviate from the Boston Noise Code is required. This is discussed in detail in the attached supplementary information. The proposed changes are being incorporated into the ongoing plans approval process with the Department of Environmental Quality Engineering.

IV. FINDINGS AND CERTIFICATION

A. It has been determined that this project is not one which may cause significant damage to the environment (Negative Assessment). ☐

B. It has been determined that this project may cause significant damage to the environment (Positive Assessment). [X]

1. The ~~draft~~ supplementary impact report will be submitted on or about: April 29, 1977

2. The ~~draft~~ supplementary impact report will be: Standard [X] Extensive ☐

3. The draft impact report will be combined: ☐

4. The ~~draft~~ supplementary impact report will be joint in conjunction with: [X]
   BRA (lead agency)
   DEQE

C. I hereby certify that this assessment has been or will be, if applicable regulations provide for subsequent circulation, duly circulated to the Attorney General, the appropriate Regional Planning Agency, and other review agencies as required by Appendix B.

April 29, 1977
DATE

Signature of Responsible Officer

Robert F. Walsh, Director
(print or type) Name of Responsible Officer

Address Boston Redevelopment Authority
Boston City Hall
~~1 City Hall Square~~
Boston, Mass. 02201

Telephone Number 722-4300

Signature of Preparing Officer (if different from Responsible Officer)

Project Manager
United Engineers & Constructors Inc.
100 Summer Street
Boston, Mass. 02110

Signature of Responsible Officer

David Standley, Commissioner
(print or type) Name of Responsible Offic

Address Dept. of Enviromental Quality Engi
100 Cambridge Street
Boston, Mass. 02202

Telephone Number 727-7770

1.0 SUMMARY SHEETS

1.1 Proposed Action

Approval is sought from the Boston Redevelopment Authority (BRA) for amendments to the Chapter 121A application in connection with the Medical Area Total Energy Plant (MATEP), an urban redevelopment project previously approved by the BRA and designed to provide members of Medical Area Service Corporation (MASCO) with steam, electricity, and chilled water. The amendments request consideration of the following changes:

. Removal of the central collection and incineration of refuse concept from MATEP to decrease air pollution emissions.

. Permission to deviate from the City of Boston Regulations for the Control of Noise.

. Addition of two extraction/condensing steam turbine generators to improve plant efficiency and reliability.

. Change in the number of boilers from three high pressure boilers, two low pressure boilers and six waste heat boilers to three high pressure boilers and two thermal afterburner - heat recovery steam generator systems to improve particulate control and to improve plant efficiency and reliability.

. Addition of a 1900 ton chiller to improve plant efficiency.

. Change in particulate control equipment from multitube cyclone particulate collectors to more efficient electrostatic precipitators for the boilers and thermal afterburners for the diesels.

. Increase in fuel use by 5% to reflect more refined data on user demands and in-plant energy demands for air quality control and noise abatement equipment.

. Increase in fuel storage by 10% to reflect refined data on the availability of storage space.

. Increase in physical dimensions of the plant to allow maximum silencing of the cooling towers and to allow for critical layout requirements within the plant.

1.2 Consequences of the Proposed Action

The proposed action will result in the following consequences:

. Air Quality - Particulate and sulfur dioxide emissions from the plant will be lower than those estimated in the FEIR. Particulate emissions will decrease 60%. Nitrogen oxide emissions for 1990 may increase slightly; however, mitigation measures which will be examined have potential for reducing the emissions below those previously estimated in the FEIR. There will be small incremental air quality impacts due to an increase in trucks (both for trash removal and fuel delivery) resulting from an additional 1740 truck trips per year (4-5 truck trips per day) over the existing conditions.

. Noise - The noise design criterion will be 60 dBA, a deviation from the literal requirements of the Boston Regulations. This deviation will result in a 5-6 dB worst-case increase in ambient noise levels for the critical receptors in the area. This increase is about the level at which increases in noise level first become discernible. That fact, combined with the actual nature of the existing environment of the area, indicates that a deviation will not cause significant impact in this particular case. There will be small incremental noise impacts due to the increase in truck trips of 1740 per year.

. Traffic Congestion - There will be an increase of 1740 truck trips per year in the area due to refuse removal and fuel oil deliveries. The operations

of these trucks will be controlled such that there will be no disruption in traffic flow patterns. All impacts will be due only to the incremental number of trucks.

. Aesthetics - Increases in the height of the cooling towers and the building size will increase the aesthetic impact of the plant. Efforts have been made to minimize this impact.

. Solid Waste Management - Removal of the incineration service will increase need for landfill volume and will increase the truck traffic in the area. MASCO will implement a business plan to centralize control and planning for refuse removal. Short-term steps will reduce the current number of truck trips by 35-40% and reduce volume by 20%. Additionally, MASCO will begin studies and make recommendations to member institutions on long-term means of reducing volume by resource recovery and/or front-end separation.

2.0 INTRODUCTION

Medical Area Total Energy Plant is to be located on a 1.7 acre site in the Roxbury section of Boston bounded on the west by Brookline Avenue, on the south by Francis Street, on the east by Binney Street, and on the north by the former Peabody Street (see Figure 2-1). The plant is intended to produce and provide one or more utilities including electricity, steam, and chilled water to 13 different user organizations which include six hospitals, four educational institutions, two research foundations, and a service vendor. The plant will also provide steam for one housing complex (see Appendix H for list of users).

The plant is being built under the provisions of Chapter 121A of the Massachusetts General Laws which require approval by the Boston Redevelopment Authority. The 121A Application was approved December 8, 1975 and the associated Final Environmental Impact Report (hereinafter referred to as FEIR) was approved January 23, 1976.

During the detailed design phase of the project following the approvals noted above, it became apparent that certain changes would have to be made in the plant to increase its efficiency and reliability to a point where it could fulfill its stated purpose. Certain other changes have been required to meet environmental considerations not anticipated during the original planning for the project. Additionally, it became apparent during the detailed design phase that the plant would not be able to meet the City of Boston Regulations for the Control of Noise as initial data indicated could be done. For these changes to receive proper consideration, it became necessary to file amendments to the 121 application for BRA approval of the changes.

The purpose of this document is to provide supplemental information to the FEIR on the environmental impacts of these changes to satisfy the requirements of the Massachusetts Environmental Policy Act (Massachusetts General Law, Chapter 30, Section 62) for an environmental impact analysis of the proposed changes.

Section 3 of this report describes the proposed changes in summary form, Sections 4 through 9 discuss the changes, their impacts and alternatives in more detail. Section 10 discusses the combined impacts of the changes. Section 11 provides responses to relevant comments received from interested parties during the development of this document.

FIGURE 2-1

PLAN VIEW OF MATEP LOCATION

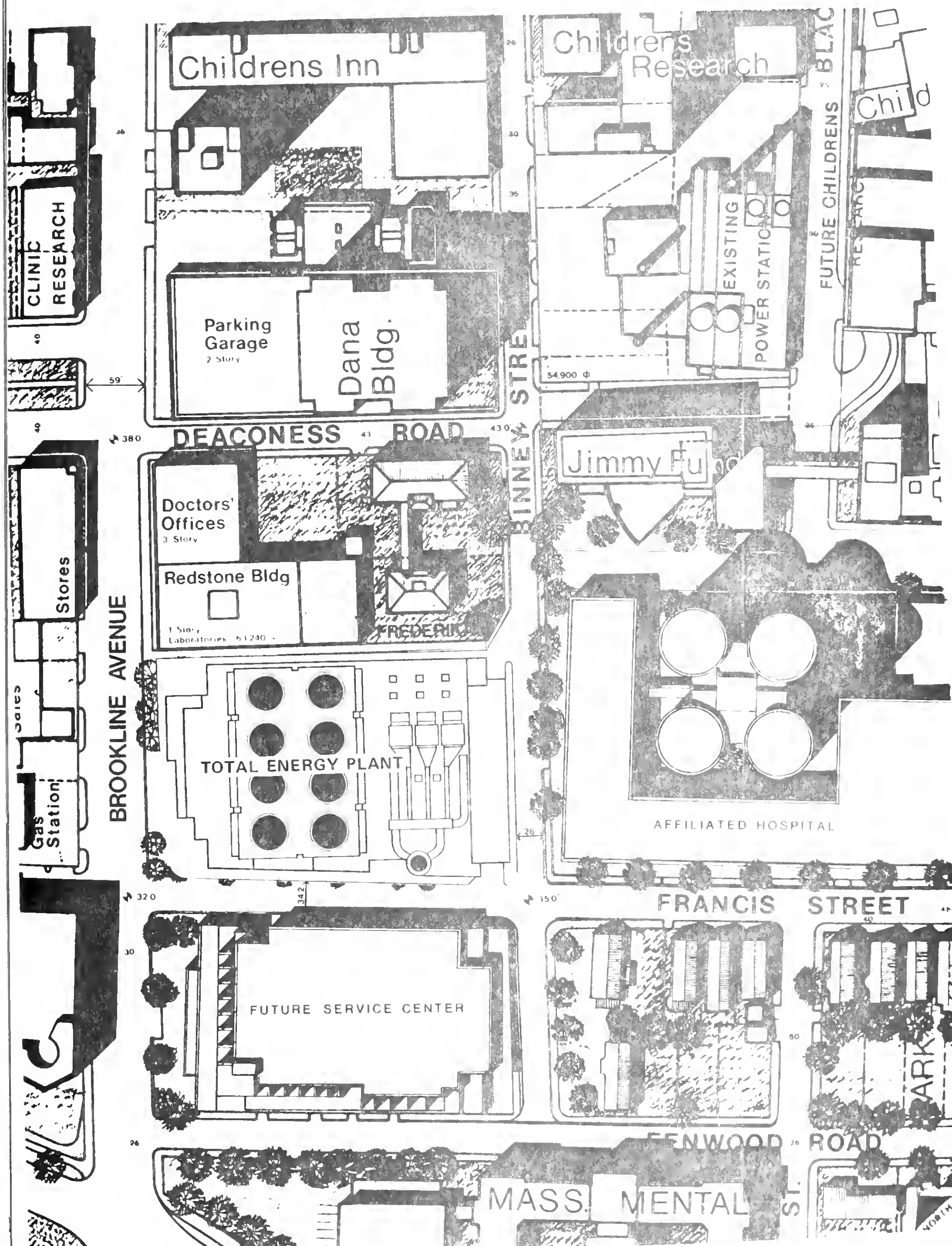
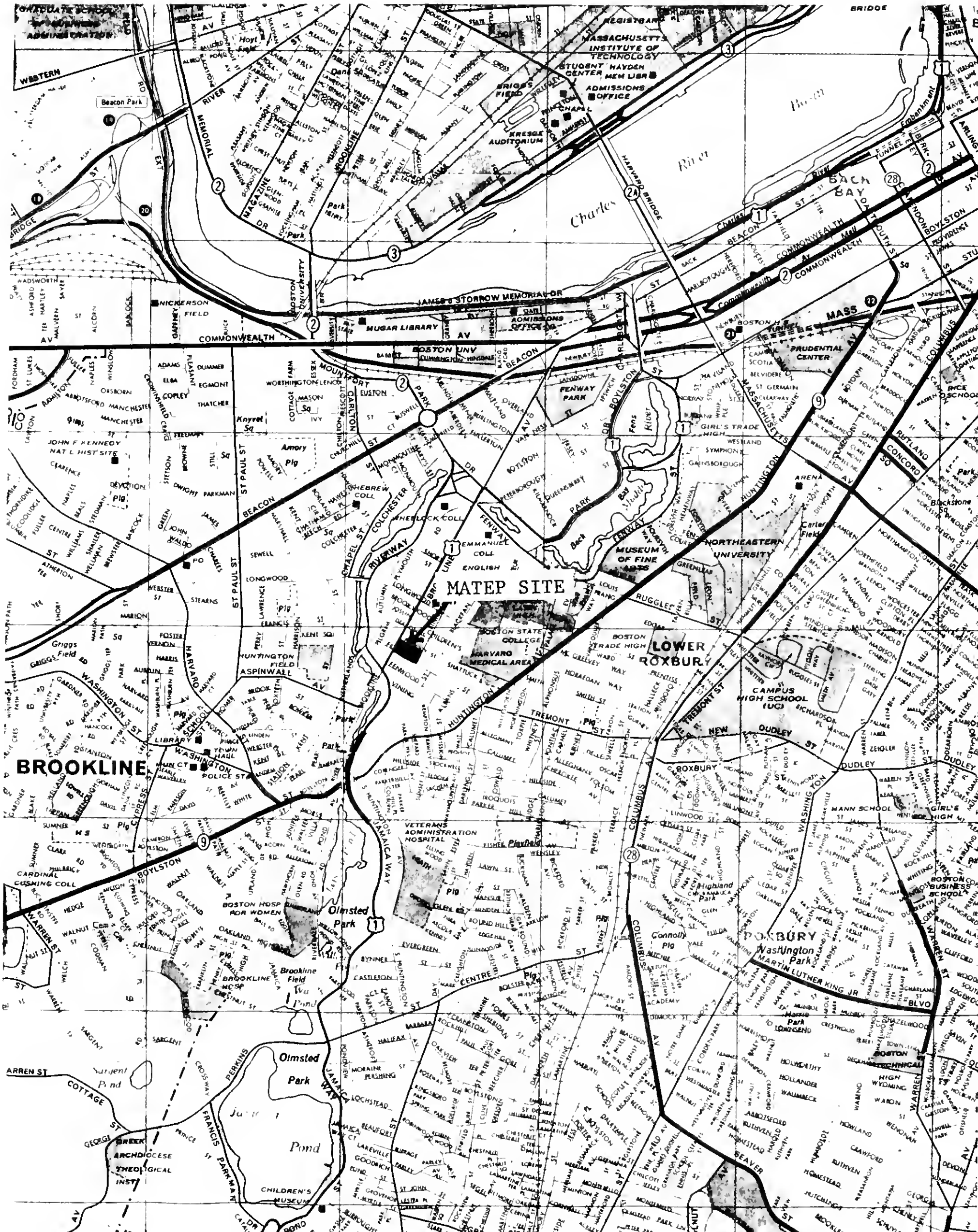


FIGURE 2-2

AREA MAP OF BOSTON



3.0 DESCRIPTION OF THE PROPOSED CHANGES

3.1 Removal of Central Incineration

The Final Environmental Impact Report included an analysis of plans for refuse incineration with a maximum capacity of 40 tons per day using 2 units each with a capacity of 20 tons per day (p. 3-1, FEIR).

The FEIR recognized the following benefits from the inclusion of the central collection and incineration service:

. Incineration of refuse thereby reducing landfill pollution and capacity problems

. Reduction of trash trucks and trash bins within the medical area.

. Heat recovery from the incineration of wastes to provide approximately 3 percent of the heat requirements for two of the boilers and 0.7 percent of the peak hourly steam generation capability.

The major recognized environmental cost of the incineration plan was the emission of various air pollutants from the incineration process (see Section 4.1 of this report).

The proposed action is to eliminate the central refuse collection and incineration service from the plant so that the plant does not have the capability to burn refuse. The benefits of this action are as follows:

. The primary benefit is a reduction in particulate emissions in an area where ambient air quality levels of particulates are of concern.

. Questions of reliability related to the central collection system indicate that the service might be a disadvantage to the users rather than an advantage.

. Refined engineering data demonstrate that there is an economic penalty associated with the concept, rather than the previously expected economic benefit.

The environmental costs of this action are as follows:

. Landfill pollution and capacity problems will not be alleviated to the degree possible by the central collection and incineration service.

. Trash trucks and trash bins will not be reduced within the area to the degree possible by the central collection and incineration service.

MASCO recognizes the need to minimize these environmental costs resulting from the proposed change. Therefore, MASCO has committed to prepare plans to centralize the refuse collection effort and to study and implement alternatives which will reduce the environmental costs. This effort is described in detail in Section 4 along with a detailed analysis of the impacts related to the proposed action and its alternatives.

3.2 Deviation from City of Boston Noise Regulations

The FEIR stated that the nighttime outdoor sound level resulting from the plant would not exceed 50 dBA (p. 5-75, FEIR). This would have allowed MATEP to meet the single number equivalent level specified by the Boston Regulations for residentially zoned areas during nighttime. This statement was considered reasonable based upon initial discussions with a cooling tower manufacturer. Refined data developed during the detailed design phase of the project resulted in the conclusion that this level could not be met after all. Further investigation has led to the conclusion that the lowest achievable noise level from MATEP is 60 dBA, the Boston Regulation daytime single number

equivalent level for residential areas. Although the Boston Regulations will not be met, a study of the ambient noise levels and sources, and the actual land use in the area indicate that the environmental impact of the deviation in this particular case will not be significant. The construction and operation of MATEP will result in the retirement of the existing Harvard Medical School power plant which is significantly noisier than MATEP will be. The impacts of this deviation and alternatives to it are discussed in detail in Section 5. Massachusetts Noise Guidelines will be satisfied.

3.3 Revised Truck Traffic Estimates

Because the central refuse collection and incineration process would have eliminated most of the trash trucks in the area, the FEIR did not address in detail the traffic situation relative to MATEP. A detailed analysis of traffic impacts is now required with the removal of the incineration process. Trucks required to supply fuel to MATEP plus the trash trucks now required are discussed. Table 3-1 provides a summary comparison of the truck trips attributable to these sources. Section 6 analyzes the impact of these trucks. Although traffic effects are a major concern in the area, the incremental effects of the increase in trucks are not significant. Additionally, the trucks do not affect the traffic flow patterns in the area, so that secondary impacts are also not significant.

3.4 Changes in Equipment

During the detailed design phase it became necessary to add or replace certain equipment items to improve the reliability and/or efficiency of MATEP. These changes are described below.

3.4.1 Addition of Two Extraction/Condensing Steam Turbines

The FEIR included plans for a back-pressure steam turbine driven generator rated at 10,300 KW. Original plans called for steam from the high pressure steam boilers to drive this turbine before being distributed to the institutions at 185 psig.

The inclusion of the thermal afterburner - heat recovery steam generator system (HRSG) as a particulate control device (see Section 3.4.4 below) dictates that, in addition to the back-pressure steam turbine, an extraction/condensing steam turbine be provided. The condensing section is needed to absorb excess steam production from the HRSG since the afterburner firing and subsequent steam production are independent of steam demand. This feature of this turbine allows useful recovery of the energy in the unneeded steam, a function which the back-pressure turbine cannot provide. The second turbine is required to insure that a condenser is always available for this regulating function. Additionally, it can serve as a back-up for one diesel generator.

Each extraction/condensing steam turbine generator is capable of generating 11,000 KW under the combined extraction/condensing condition. The extraction stage delivers exhaust steam at 125 psig and can operate only if there is a demand for steam by the users. The condensing stages of the turbine can generate 7,500 KW of electricity with no extraction steam flow. During peak electrical load periods, which occur in the summer, the user steam demand is very low and not particularly dependable, therefore, it cannot be considered as a source for generating firm electrical power. Under summer load conditions the diesel generator waste heat is sufficient to generate enough steam to operate only one extraction/condensing turbine underload. The second unit is available as a back-up for the first unit or a diesel. Thus the increase in firm electrical generation is limited to the equivalent of one unit (7,500 kw).

However, this increase is only a by-product of the need to improve plant efficiency and reliability and does not reflect increased utility demands.

3.4.2 Change in the Number of Boilers

The FEIR included the following boilers:

- Three high pressure steam boilers with a steam production of 180,000 lb/hr at 650 psig and 750^{o}F with a fuel consumption rate of 12,800 lb of No. 6 fuel oil per hour.
- Two saturaged steam boilers with a steam production of 180,000 lb/hr at 450 psig and a fuel consumption rate of approximately 10,900 lb/hr.
- Six heat recovery boilers with a total steam production of 94,000 lb/hr.

It is now planned to keep the three high pressure steam boilers and replace all the other boilers with two thermal afterburner-heat recovery steam generators each operating at 180,000 lb/hr of steam at 650 psig. These changes were made to increase the reliability and efficiency of the overall plant cycle and to provide a means for incinerating the diesel engine exhaust to provide particulate emissions control.

The effects of this action are to reduce particulate emissions from the plant and to decrease the total steam generating capability of the plant. This is possible because refined data show a lower future heating steam load growth than originally estimated. Also by generating all steam at 650 psig, 750^{o}F the plant is able to maximize the generation of electricity by back pressure or extraction modes at the most favorable heat rates.

3.4.3 Addition of 1900 Ton Chiller

The FEIR included plans for four 5000 ton centrifugal chilled water generators for air conditioning. Two of these units will be driven by steam turbines and two by electric motors.

The proposed change is the addition of a 1900 ton motor driven chiller presently located in the existing Harvard power plant. This chiller will supply the low chilled water demands during the winter months. The smaller chiller will be able to operate near its full load point during the winter months; hence it will be more economical for plant operation. Also, this smaller unit can be used during the summer period to satisfy peak demands more economically than starting a 5000 ton steam driven chiller.

3.4.4 Change in Particulate Control Equipment

The FEIR included plans to use multitube cyclone particulate collectors for control of particulate emissions from the plant.

The proposed changes will result in the use of more efficient particulate control devices. Each of the three package steam generators will have its own electrostatic precipitator. Two thermal afterburners in the heat recovery steam generators will be used to incinerate the diesel exhaust.

The result will be the benefit of a decrease in particulate emissions as discussed in Sections 7 and 10. Increased capital and operating costs will result.

3.5 Change in Fuel Use and Storage

The FEIR estimated initial fuel use to be 23,341,000 gallons per year increasing to 27,076,680 gallons by 1990.

These estimates have been increased to 24,400,000 gallons per year increasing to 28,500,000 gallons by 1990. This increase of 5% has resulted from refinements in design and increases in in-plant energy requirements for

air quality control and noise abatement equipment not previously anticipated. This slight fuel increase is not accompanied by increases in air pollutant emissions because of the better particulate control equipment being used and an increase in the relative amount of cleaner No. 2 fuel oil burned in the plant. This is discussed in more detail in Section 10.

Trucks trips will increase slightly. This is discussed in more detail in Section 6.

The FEIR included plans for the following underground fuel storage:

No. 6 fuel oil	1,100,000 gallons
No. 2 fuel oil	25,000 gallons
Lube oil	25,000 gallons
Total	1,150,000 gallons

The proposed change is an increase in total fuel storage distributed as follows:

No. 6 fuel oil	1,070,000 gallons
No. 6 fuel oil, washed	24,000 gallons
No. 2 fuel oil	140,000 gallons
Lube oil	7,500 gallons
Total	1,241,500 gallons

The change is the result of a refined calculation of actual available oil storage space and a re-analysis of the amount of No. 2 fuel oil consumed daily with the inclusion of the thermal afterburners, which incinerate the diesel exhaust. The increased storage amounts to 91,500 gallons, less than 10% of the total fuel storage. The only effect of this increased storage will be a requirement for 15 additional fuel delivery trucks initially to fill the tanks. Since the initial fill of the tanks will be spread out over some weeks, this increase will not be significant.

3.6 Change in Physical Dimensions

The FEIR included plans for cooling towers which had a height of 90 feet above grade. The proposed change calls for the maximum cooling tower height to be about 140 feet above grade. Actual cooling towers purchased may not be this high. The height increase is required to allow extensive silencing of the cooling towers to reduce noise levels to the lowest achievable. Section 9 discusses the potential effect of this change upon aesthetics and potential downwash effects of the higher towers on the stack. Neither effect is considered to be significant.

The FEIR included plans for a building-site arrangement which allowed liberal open space and pedestrian walkways on Brookline Avenue and Francis Street. Engineering needs, including the requirement for maximum roof space to allow silencing of the cooling towers to the lowest achievable level, dictated that the building take up more room on the site. Pictures are provided in Section 9 to illustrate the effect of this change upon aesthetics. Sufficient space and architectural treatment is still available to maintain the original intent of the design; that is, to enhance the human scale of the plant at the pedestrian level through extensive use of glass (along Brookline and Francis Street) with arcades, overhangs, landscaped plazas, and the use of brick as the principal exterior material.

TABLE 3-1

SUMMARY OF TRUCK TRIPS

TRUCK TRIPS PER YEAR	FEIR		REVISED	
	EXISTING (PRE-MATEP	1980 (POST-MATEP)	EXISTING	1980
Trash Trucks	5200	0	2600	2220
Fuel Delivery	1890	3890	1950	4070
Total	7090	3890	4550	6290

4.0 REMOVAL OF INCINERATION SERVICE

4.1 Summary

The system originally proposed by the Medical Area Total Energy Plant, Inc. (MATEP) for the removal and recovery of solid waste from the medical institutions served by the Medical Area Service Corporation (MASCO) consisted of pneumatic trash conveyance to a central incinerator. The heat generated by this incinerator would then be utilized to convert water to steam; i.e., an energy recovery system. In spite of the presumed benefits responsible for the initial proposal, subsequent analyses suggested that there were a number of unresolvable in-plant and user disadvantages associated with the system. Moreover, the additional increments predicted for the regional (Metropolitan Boston Instrastate Air Quality Control Region) air pollutant emission burden (in particular, emissions of total suspended particulates) due to the central incinerator are inconsonant with state and federal goals to reduce particulate emissions in the Boston area. Therefore, it has been proposed that the initially planned incineration service be replaced with a program of centralized control of refuse removal by MASCO. Pursuant to this end, the MASCO board has voted (see Appendix D) to adopt a <u>business plan</u> consisting of the following activities.

1) Centralized planning for waste volume reduction and most efficient truck removal, with the objective of reducing truck trips and upgrading the aesthetic characteristics and maintenance of the refuse areas of each source. Key elements in this effort will be the central control of truck removal through the use of a single disposal contractor and the acquisition of improved compaction equipment.

2) MASCO will initiate a study and pursue implementation of short and long-term alternatives to the refuse removal problem. These alternatives will be studied and the required groundwork laid with the member institutions to improve the situation by limited or full scale material recovery-front end separation programs. MASCO will assume the responsibility for developing

a program and initiating the negotations which could lead to the adoption of resource recovery as a long-term policy of the member institutions.

The following sections describe a number of short-term and long-term alternatives to the originally proposed central incineration system and their associated impacts. The major short-term (6-12 months) alternatives addressed are centralized management, source separation, and limited front-end recycling (including replacement of disposable products with re-usable ones). The discussion of long-term options focuses on improved centralized (regional) collection systems and regional resource recovery. In the discussion of potential impacts, an attempt has been made to address a number of key points raised in the March 24, 1977 memorandum from the Secretary of the Executive Office of Environmental Affairs (provided in Section 11) as follows;

- More comprehensive consideration of alternative waste disposal systems;
- consideration of waste reduction programs with the primary goal of increasing the life expectancy of existing sanitary land-fills;
- aesthetic and sanitation problems associated with the existing distribution of refuse containers and disposal practices; and
- the impact of alternative systems on total truck trips.

Impacts are discussed with respect to existing practices, potential health and environmental benefits, and economic trade-offs.

4.1.1 Description of Incineration System that Would be Eliminated

The incineration and pneumatic trash conveyance system has been described in the Final Environmental Impact Report which was submitted to the Executive Office of Environmental Affairs on September 29, 1975. The incineration system was originally planned primarily to serve the members of MASCO by way of a penumatic trash conveyance system. The original concept of incineration and conveyance is briefly described below.

Two 20-ton per day incinerators were to be installed each having the capacity to handle the institutions' load during a 17-hour period. The incinerators were to be used only for general refuse. They were to be designed with a dumping grate and refractory furnace operating with 200 to 300% excess air. Flue gas temperature were expected to be about 800°F before entering heat recovery boilers. The heat recovery boilers were to have been used after the incinerators, each with a capacity to produce approximately 7,000 pounds of steam/hour at 185 psig to recovery as much heat as possible for this operation.

Operation of each incinerator would have been on a batch basis as a measure to achieve complete combustion. No. 6 residual oil was planned to be used as an auxiliary fuel at a rate of about 100 gallons per hour. The flue gases were to be used as partial combustion air for two of the steam boilers which were expected to act as afterburners and eliminate any odors. Multicyclone type of particulate collectors were proposed to remove particulate matter from the flue gas before the flue gas went to the heat recovery boilers and steam boilers. Ash collected in the cyclones was to be reintroduced into the incinerator. It was expected that all ash from the incineration process could have been removed from the Total Energy Plant once a week in a 30-ton capacity truck.

Trash was to be conveyed to the Total Energy Plant by a pneumatic system which would have been connected to each member of MASCO. The pneumatic system would have been placed in the distribution tunnel which would have carried the steam, chilled water and electricity to the MASCO members.

The recent engineering reevaluation and redesign of the concept of incineration by United Engineers & Constructors, Inc., has determined that the incineration system would have to be different from that presented in the Final Environmental Impact Report if it were to be included in the Total Energy Plant. This more recent design is described in Appendix C of this report.

4.1.2 Modifications of Characteristics of the Total Energy Plant Resulting from the Proposed Action

Eliminating the pneumatic conveyance and incineration system will not change the original purpose of the Total Energy Plant or significantly alter external aspects of the project. As originally planned,

the incineration would have provided approximately 3% of the heat required for two of the boilers and would have provided about 0.7% of the peak hourly steam generation capability of the Total Energy Plant. Removal of incineration would require additional heat to be supplied to account for the heat that would not be available from incinerators. This would require approximately 500,000 gallons of fuel oil per year which is about 2% of the annual fuel consumption for the total plant. However, handling the low pressure steam and controlling the exhaust gases to the steam boilers from the incinerators would have created more problems than the savings in heat would have warranted.

Some of these problems include the following:

1) The generated low-pressure steam would not be available for production of by-product electric power as would the other steam produced in the plant;

2) The incineration operation would serve as an uncontrolled source of low-pressure steam which would create disturbances in the operation of the other steam processes, i.e., the extraction turbines. This would complicate control functions within the plant;

3) The use of incinerator exhaust gas, with its variable oxygen quantities, as combustion air for the package steam boilers would greatly complicate the combustion control system; and

4) The unknown composition of the incinerator exhaust gas would have a potential for adverse effect on the maintenance and lifetime of the package steam boilers.

The prime effect of eliminating the incineration system from the Total Energy Plant is avoiding the emission of air contaminants that would be associated with incineration. Table 4-1 lists emissions which would be avoided by eliminating the incineration. A wide range of estimates of emissions is contained in Table 4-1 because it contains those emissions due to incineration as presented in the Final Environmental Impact Report and emissions from an incineration system that would be installed based on current designs if incineration were to be included in the Total Energy Plant.

An incinerator at the Total Energy Plant emitting particulates at a rate of 1.4 pound per ton of refuse would emit 3.2 pounds of particulates per hour based on burning 39 tons of waste during a 17-hour day. Based on calculations of particulate contributions to ambient air quality presented in the Final Environmental Impact Report, these emissions would be responsible for a peak 24-hour concentration of 0.21 $\mu g/m^3$ and an annual concentration of 0.013 $\mu g/m^3$. (The applicable 24-hour and annual particulate air quality standards are 150 $\mu g/m^3$ and 60 $\mu g/m^3$, respectively.) Since the greater Boston area is considered by the Department of Environmental Quality Engineering to be a nonattainment area for particulates, avoiding particulate emissions would be beneficial.

In addition, since a variety of plastic materials may be contained within the institutional wastes that were to be burned, organic acids may have been formed in the incineration process. Elimination of incineration would avoid any problems that may be associated with the burning of plastics.

Removal of the incineration system will allow some of the rooftop equipment that would have been associated with the incineration system to be eliminated. This will improve the rooftop appearance. In addition, the space made available by removal of incineration equipment can be used to advantage for laying out other pieces of equipment within the Total Energy Plant.

Operating and maintenance personnel and power requirements necessary for incineration would also be eliminated. Plant reliability would be enhanced because the potential for hazardous combustible materials to enter the Total Energy Plant would be avoided.

Other aspects of the Total Energy Plant such as noise generation, water usage or truck traffic to the Total Energy Plant will not be significantly affected by removal of the incineration system.

4.1.3 Implications on Solid Waste Collection Resulting from the Proposed Action

Elimination of the incineration and pneumatic trash conveying system from the Total Energy Plant would require that MASCO members

use other methods to remove its solid waste from the area. Alternative solid waste systems are covered in the following sections.

4.2 Alternatives and Impacts

4.2.1 Introduction and Summary

There is a variety of short and long range alternatives to the proposed action of eliminating incineration and the pneumatic conveyance of trash from the Total Energy Plant (MATEP). These options fall into six (four short-term and two long-term) general categories, enumerated below.

Short-term Alternatives

- Conventional systems in current operation at MASCO member institutions;
- Short-term modification and improvement of existing equipment and housekeeping procedures;
- Limited on-site recycling and replacement, where possible, of disposable products with reusable ones; and
- Limited front-end source separation of disposables (primarily paper products) for which regional recycling facilities are currently in operation.

Long-term Alternatives

- Centralized collection systems, involving transport to a central facility for waste volume reduction and removal; and
- Regional resource recovery plan, involving transport of wastes to a major metropolitan area facility for recovery of energy and/or materials.

Studies conducted by Benjamin Thompson & Associates, Inc. (BTA) and by Environmental Research & Technology, Inc., (ERT) have addressed those options which are especially appropriate for inclusion in this component for the MASCO business plan. These options, in essence, fall into the first four categories listed above.

Conventional systems (i.e., the first category above) consist essentially of manual carting of wastes to on-site dumpsters or dumpster/compactors followed by truck transport to a sanitary landfill. A number of options under the next three short-term categories are in varying stages of implementation within the Medical Area, while others are being contemplated. It is believed that many of the short-term options discussed in this report could be implemented within six months or less, depending primarily on such factors as equipment procurement schedules, availability of funds, time required for personnel training and the existing complexities of administrative channels.

The long-term options discussed in this report are, at present, beset with a variety of technical, economic or political difficulties. While these options show promise on the basis of research or pilot programs in other cities, it is estimated that considerable time (e.g., 10 years or more) will be required before any of these systems could become operational in metropolitan Boston. A major problem associated with energy and material recovery systems, for example, is the uncertainty of future markets for recovered products balanced against the substantial capital and operational costs required for such systems. However, the U. S. Environmental Protection Agency through the Solid Waste Disposal Act is, via federal grants, encouraging regional (e.g., metropolitan) areas to develop comprehensive management programs. Moreover, it has been established through pilot programs that centralized collection and resource recovery can be designed as mutually complementary systems. Finally, it is anticipated that the scarcity of landfill sites, the continuing depletion of traditional fuel reserves and raw materials, and environmental concerns will provide the impetus for accelerated research and development in this vital area of endeavor.

Alternative Solid Waste Systems for MASCO

A central objective of this study is to evaluate the short and long range alternatives available to reducing the volume and negative environmental impacts of Medical Area solid wastes. To this end, estimates have been made of three essential input parameters for each alternative under consideration, including the original (discarded) option of pneumatic collection and incineration. The parameters

evaluated are (1) percent of solid waste recycled, (2) weight of solid waste transported to sanitary landfills, and (3) trash truck trips. The figures are presented in Table 4-2. The estimates for the short-range alternatives are based on current observations and inventories, while the pneumatic collection/incineration and regional resource recovery alternatives were evaluated on the basis of existing technology. In the case of the pneumatic collection/incineration and conventional truck-to-landfill alternatives, both the Final EIR and most recent estimates are provided for comparison. There are a number of qualifications on the figures presented in the table. However, the following conclusions can be made:

- Regional resource recovery offers, by far, the greatest potential for solid waste reduction, although truck travel would be essentially unaffected;
- Centralized collection (which could be used in conjunction with either short-term or long-term resource recovery options) could reduce the number of truck trips by nearly 90% from the existing system; and
- Short-term resource recovery measures can make measurable contributions toward reducing solid wastes at MASCO member institutions. These contributions would vary depending on current housekeeping and recycling practices of each member.

The objective of the remainder of this section will be to discuss, in some detail, the implications of Table 4-2 in the context of current literature on hospital solid waste inventories and housekeeping practices, environmental and economic trade-offs, and state-of-the-art waste disposal and resource recovery technology.

4.2.2 Existing Conventional Solid Waste System

In order to obtain an indication of the environmental conditions associated with the current solid waste handling, storage, and removal practices of MASCO members, a series of site inspections were performed on November 17 and 19, 1976, by a representative of Environmental Research & Technology, Inc. Individuals responsible for disposal of solid waste at each institution were contacted either by telephone or in person. The scope of this survey was confined to general solid waste not requiring special handling such as garbage, bottles, cans, paper, plastics, dirt and animal litter. Wastes of a hazardous nature requiring special handling, such as biological and radiological materials, were not considered in this survey, since these wastes are handled separately.

Information on the existing waste handling situation was also derived from a survey prepared by Charles G. Hilgenhurst and Associates on September 24, 1976, and from a solid waste disposal study prepared by United Engineers & Constructors, Inc., in November 1976.

Another survey of existing conditions and study performed by Benjamin Thompson & Associates (BTA) was recently completed. The BTA study was designed to develop improvements to the existing conventional solid waste system and is discussed further in Section 4.2.3.

Information obtained from these surveys consists of (1) a physical description of the individual waste systems, and (2) a qualitative assessment of environmental conditions.

Storage Facilities

Locations of the existing solid waste storage and removal locations used by the various institutions within the vicinity of the MASCO area are shown in Figure 4-1. The solid waste is stored, prior to removal by contractors, in either standard open steel bins, dumpsters, typically of 3 to 6 cubic yard capacity or larger container-compactor units of 10 to 40 cubic yard capacity. In a few instances, plastic bags are stored in building areas. A listing of the location and type of waste storage facilities at each of the MASCO member institutions is presented in Table 4-3.

In general, waste storage containers are in areas normally not frequented either by the public or by employees (other than these connected with waste removal operations). Such areas are typically loading docks and alleys. Some of the waste container units are located in parking lots and other areas traversed infrequently by the public or by employees. The land uses noted in the vicinity of the waste container units were exclusively institutional.

Solid waste is manually collected from within the institutions and brought to centralized storage facilities by hand carts of approximately 1 to 2 yard capacities. The general routing of these carts is from waste generation areas, down service elevators, and along first floor or basement corridors to the storage point. This may entail considerable outside travel in some cases.

Waste Disposal

Four different private contractors presently service MASCO member institutions and each institution has its own contract. Approximately 90% of the total weight of waste disposed of is handled by two firms. Of the total weekly volume of trash removed, approximately 1,300 yards, 1,000 yards is compacted and stored on site. The remaining 300 yards are stored uncompacted and are removed by compactor trucks. In terms of weight, the percentage of trash compacted during storage is approximately 90% of the total trash. Pickup of waste occurs at a range of times during the day, with a concentration of pickups in the 7:00-9:00 AM time period. No pickups are made on Sunday.

On-site compaction is accomplished by an electric motor-hydraulic pump and piston unit which is installed at an institution's trash storage site. A portable enclosed steel box (roll off container) to receive the compacted trash is mated with the compactor unit. This box is removed by the contractor, either on a regular schedule or on a call basis. This box is disconnected from the compactor and pulled by a winch and cable mechanism onto the roll-off truck. This loading operation is relatively brief, lasting 5 to 10 minutes depending on

accessibility of the truck to the storage point. The contractor then removes the compacted waste to one of the municipal or private waste disposal facilities currently being used in the Boston Metropolitan area.

Within a period of one-half to one hour, the contractor returns with an empty container and unloads and mates the empty container with the compactor unit. The operation of unloading an empty box takes about the same amount of time as the removal of a filled box.

Loose trash stored in either plastic bags or open dumpster containers is picked up by compactor trucks and compacted at the time of pickup. In the case of containers, these are tipped into the receiving end of the truck (hopper), inverted, emptied, and then tipped back to their original position at the site. Bagged material is thrown by hand into the truck's hopper. A power take off driven hydraulic system operates the truck's integral compactor system which packs the loose trash tightly into the body of the truck. The trash removal time for the dumpster storage system is roughly the same as for the on-site compaction system, varying from 5 to 10 minutes depending on container size, type of waste in the container and ease of access to the container.

Quantities of Wastes

The quantity of wastes presented in the Final Environmental Impact Report were based on data then available to the Design Engineer. This information indicated that an incinerator with a capacity of 20 tons per day could dispose of trash from the MASCO member institutions by operating 17 hours per day, six days a week. These figures translate into a capability of burning 4,420 tons of trash per year.

As the design of the Total Energy Plant has continued, additional efforts have been made to define the wastes which must be removed from the institutions. Tonnage and volume of wastes generated have been difficult to define because method of compacting, density of compacted material and daily quantities of waste produced are not consistent throughout the MASCO member institutions. Estimates of wastes made by United Engineers & Constructors, Inc., were based on weekly tonnage data by Beth Israel Hospital, Peter Bent Brigham Hospital and Children's

Hospital Medical Center, estimates of employee and patient populations, and data from the Harvard University Medical School. These estimates have indicated that about 26 tons of waste are collected per day. Based on six-day weeks, this is an annual weight of waste of 8,112 tons.

Based on a similar survey of waste disposal practices by MASCO members and the type and size of containers used by the institutions and the frequency of pickups, ERT estimates that the current weight of trash produced could be about 28 tons per day, equivalent to 8,740 tons per year. The ranges of estimates of waste tonnages are shown in Table 4-4. The current estimates and future projections of waste tonnages have not included wastes from the Mission Park Housing Development.

Several factors exist, which will result in significant increases in the rates of solid waste generation in medical area. One factor is the growing use of disposable medical and other supplies by medical area institutions. The other is growth in institutional size, due to recent construction of new facilities and expansion of medical services. An analysis of these factors by UE&C indicates that the medical area solid waste generation will increase in 1980 over the current rate by approximately 40% and by 1990 by approximately 80%. A comparison of estimates of daily and annual waste production rates and the estimated 1980 and 1990 rates is presented in Table 4-4.

Truck Trips

The annual number of trash truck trips presented in the Final Environmental Impact Report was estimated by MASCO to be approximately 5,200 trips or an average of 100 trips per week. This value for annual trips was based upon an extrapolation approach using number of trips and trash removal service cost data for one member institution and the total costs for all MASCO members waste removal service. Since the automated collection system as originally conceived would have eliminated reliance upon trash trucks, a more accurate estimate of the number of trash trucks was not considered necessary for the Final Environmental Impact Report. Since the proposed action would cause reliance on trash trucks to continue, ERT has attempted to reevaluate the numbers of trash trucks that are being used.

The results of the recent ERT survey of MASCO solid waste removal, a survey conducted by C. Hilgenhurst and Associates, and estimated by UE&C, indicate that there is presently a range of six to eight truck trips per day (one trip corresponds to a truck entering and leaving the medical area) or approximately 1,820 to 2,600 trips per year. These results are shown in Table 4-4. This information was based upon direct observation of existing waste collection methods and current pickup schedules, which are presented in Appendix B. Review of the trash pickup schedule, presented in Table 4-3, indicates that the daily number of truck trips is relatively constant over six days of the week. Since one contractor handles most of the wastes, it is reasonable that truck trips would be evenly spread throughout the week so that the contractor's fleet of trucks would be used effectively. (No pickups are performed on Sunday.) Therefore, it is believed that an average of eight truck trips per day represents the upper level of current trash truck activity in the medical area. Future increases in solid waste could increase the daily average number of trips to 15 trucks per day in 1990.

The same factors used to project future solid waste generation were used to project numbers of trash trucks.

Effects on the Environment of Continuing to Use the Existing Waste Collection System

The following paragraphs describe some of the environmental conditions associated with the storage and truck transport of MASCO member solid waste. In terms of impacts upon people, several factors should be considered. First, as noted previously the storage containers are typically located in out-of-the-way areas, such as loading docks, so that they are removed from the general public and from people in the institutions. Second, the truck operations associated with waste removal are relatively brief, lasting from 5 to 10 minutes, depending primarily on the accessibility of the storage container to the removal truck. Third, trash truck activities are generally in areas where other trucks are working.

General Conditions Near Storage Containers

During a brief survey, conducted in November 1976, ERT found that the environmental conditions near waste storage containers to be generally excellent. Only in one or two instances was some local litter observed, and this was confined to an area within a few feet of the storage container. In one instance, a smelly liquid was observed leaking from a compactor unit and running into a nearby storm drain.

A number of MASCO member organizations have specific, written, guidelines for the internal collection of waste and the maintenance of the waste storage area. These procedures include regular disinfection of hand carts and storage equipment as well as sweeping and washing the storage area after the contractor removes the storage container.* In several instances the implementation of these procedures was observed. The establishment and application of these procedures is an important aspect of preventing insect and rodent problems.

Noise Conditions

Noise levels associated with trash trucks are a function of the type of truck, its mode of operation and the distance to receptors. There are two types of trash truck serving the medical area: the roll off container truck and the compactor truck, each of which spends some time at waste storage areas and some time traveling within the medical area. The pickup of dumpster and bagged waste by compactor type trucks is a relatively noisy operation. Operation of the truck's loader-compactor generated a noise level of 85 dBA at a distance of approximately 50 feet from the truck. Noise levels of this amount are sufficient to preclude ordinary speech communication and would be found sufficiently annoying by most people to cause them to avoid the area of the loading operation.

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*Telephone conversations with some waste removal contractors revealed that these contractors wash and sterilize the containers during the warm weather months.

Unloading a large compactor unit is a much quieter operation. Noise levels at 50 feet of approximately 70 to 75 dBA were measured. The operation of the compactor unit itself is quiet: levels of 75 dBA and less at 5 feet from the compactor and were measured at a number of different units.*

The roll off and compactor trucks observed operating within the medical area are diesel powered vehicles, which produce street noise levels varying from 76 to 91 dBA (at a reference distance of 25 feet), depending on whether the truck is idling or undergoing acceleration. Thus, the highest noise levels experienced by pedestrians occurs during the relatively brief period when a trash truck passes.

Traffic Congestion

It is not believed that the current method of removing wastes from the medical area is a significant contributor to traffic congestion which occurs in the medical area. This is because the average daily number of trash trucks is about eight. Traffic volumes in the area were determined by Wilbur Smith and Associates and presented in the Final EIR. Comparison of total traffic volumes to trash truck trips indicates that 12 trash trucks (in the year 1980) would be a small percentage of current traffic volumes. For example traffic volumes during the peak morning hours on streets in the area have been measured as follows:

Brookline Avenue	-	1,500 vehicles per hour
Longwood Avenue	-	888 vehicles per hour
Huntington Avenue	-	1,400 vehicles per hour
Binney Street	-	300 vehicles per hour
Francis Street	-	620 vehicles per hour

While turning movements of trash trucks can cause a momentary traffic delay by blocking traffic flow as it waits to turn, the small number of trash trucks that serve the institutions is not considered to be a significant source of traffic congestion. Some trash trucks that

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*Noise levels inside a (highly reverberant) loading room for one compactor unit measured approximately 85 dBA. However, this represents an occupational health consideration rather than an exterior environmental effect.

serve the institutions have been observed to operate during the morning rush hour and several pickups are scheduled for that period. If any problem of early morning traffic congestion occurs the truck movements could be rescheduled. No trash removal is scheduled for the late afternoon when traffic congestion is greatest.

The storage facilities which must be emptied are located off private roads, parking lots, alleys and loading docks of institutions. Therefore, operation of waste pickup would not generally block through roads used by the public. Illegally parked employee vehicles and delivery trucks interfere with the movements of the trash trucks by blocking access to the storage containers. Trash trucks maneuvering into position to empty storage containers may block movements of vehicles in the streets among the institutions.

Air Quality

Trash trucks are a source of air contaminants, primarily carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NO_x). Nitrogen oxides and hydrocarbons (nonmethane) are potentially hazardous through their ability to react in the presence of sunlight, producing photochemical oxidants. However, since this is a process which requires considerable time and, hence, occurs over downwind transport distances on the order of several miles, these pollutants are ordinarily addressed in a regional, rather than local, analysis of air quality impact. The effects of carbon monoxide, on the other hand, are most pronounced at close distances from the source and are, therefore, evaluated locally. The low number of trash trucks in relation to total vehicles in the area makes the trash trucks minor contributors to the overall level of air quality both on a local and regional basis. For comparison purposes Table 4-5 presents contaminant emission rates for heavy duty diesel trucks and light duty vehicles. This table shows that carbon monoxide emissions are lower from a diesel truck than from a light duty vehicle while the reverse is true for nitrogen oxides.

Since the number of vehicles in the area during the peak morning hour is high, the contribution from eight diesel trash trucks, if they were all there at the same time, would be low. This is especially true for CO, the primary vehicular pollutant of interest on a local (near field) scale, inasmuch as automobiles currently emit two to three times as much CO, per vehicle, as heavy-duty diesel vehicles. For example, if the 1,500 cars on Brookline Avenue were traveling at 10 miles per hour, (cycle average speed), the total CO emission rate would 117,800 grams per mile. Twelve trash trucks at the same speed would be emitting CO at a rate of 365 grams per mile. This would be about 0.3% of the current total carbon monoxide emitted. It should be recognized that the traffic in these areas in the peak morning hour is greater than the 1,500 vehicles measured on Brookline Avenue, and the percentage contribution of air contaminants emitted from trash trucks that serve the institution should be considerably less than the figure estimated for Brookline Avenue.

ERT conducted a brief carbon monoxide (CO) measurement program on December 20, 1976 to see if CO concentrations from a trash truck are significant. Since the measurement program was brief, the results cannot be extrapolated to cover effects of trash truck operation at all times. However, the measurements did show that background levels were low and that no effect of trash truck operation could be seen. Carbon monoxide levels were measured in the vicinity of trash storage containers for a period of time before, during, and after trash truck servicing of both dumpster and roll off containers. Wind speeds ranged from calm to about 5 mph, and the instrument was moved to a range of distances (30 feet to 3 feet) downwind of the trucks in order to detect maximum CO concentrations. The measurement results indicated that the operation of the diesel trash trucks did not result in measurable increases in local CO concentrations. During the measurement period, between 6:30 AM to 11:30 AM, background CO concentrations ranged between 4 to 8 ppm, with transient peaks to 17 ppm resulting from pre-1976 automobiles. The hourly carbon monoxide concentrations and even the peak momentary concentrations are well within the National Ambient Air Quality Standard of 35 ppm for maximum 1-hour CO concentrations. Although this field measurement data and Table 4-5 data cannot be used to say that the CO standards are not exceeded in the area, it does indicate that the contribution from trash trucks is negligible.

Landfill Capacity

At present, approximately 80% of the solid waste generated by MASCO members is disposed in the recently opened commercial sanitary landfill in Plainville, Massachusetts; 10% is disposed in the Saugus commercial incinerator; and the remaining 10% is disposed in Boston's Gardiner Street landfill operation. According to Mr. Paul Anderson, DEQE regional engineer, the Plainville landfill has a ten-year lifetime at the current design fill rate of 750 tons per day.* MASCO's average daily contribution (28 tons x 0.8) represents about 3% of this figure and could therefore be expected to affect the landfill life expectancy by about 3-4 months. If the daily fill rate is increased to 1500 tons per day, the lifetime would be cut to 5 years. The impact of MASCO waste, in this case, would only be about one month on landfill life extectancy. Hence, current disposal practices therefore represent a small reliance on the city's limited capacity landfill operation and do not appear to have any short-term impact on significant landfill capacity.

4.2.3 Proposed Alternative of Improving the Existing Conventional Solid Waste System

Introduction

Although the existing solid waste practices in the MASCO institutional area could be continued without creating significant environmental damage, the business plan being developed by MASCO represents a comprehensive attempt to improve the situation. The alternatives proposed under this plan rely on a combination of the existing solid waste system and a series of improvements and modifications.

By replacing the existing fragmented individual institutional solid waste approach by a centrally coordinated, MASCO controlled system and by making certain physical changes to some of the trash storage and pickup facilities, the following tangible benefits can be realized:

- a 35-40% reduction in the total number of trash truck trips;
- elimination of conflicts between automobiles (parking spaces) and trash storage containers at two trash storage locations;

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*Per information supplied February 11, 1977.

- improvements in the aesthetics and sanitary conditions at seven waste container sites;
- elimination of some isolated conditions (two cases) where operator safety hazards now exist;
- reduction of the overall cost of the solid waste system; and
- reduction of noise impacts by localizing operations where acoustical treatment (noise abatement) may be feasible.

The following sections describe in detail the specific improvements in the existing solid waste system which are required in order to obtain these benefits. This alternative is viable in terms of really achieving these benefits within a relatively short time period (within six months); there is a commitment by the MASCO board to proceed with the development of a business plan to incorporate the required system improvements. See Appendix D for letters from MASCO member institutions expressing a commitment to pursue development of this business plan. As further evidence of the interest and commitment of MASCO, the record of the MASCO board vote of April 13, 1977, is also included in Appendix D. There does not appear to be any organization limitations to implementing the improvements. Furthermore, there are no technological or economic barriers; the requirements for new equipment are modest, and this equipment has proven to function as specified in a reliable fashion in a number of actual hospital installations.

Beyond the tangible, short-term benefits described previously is the potential of achieving even greater longer term benefits. By virtue of establishing a cooperative planning capability within the MASCO organization, MASCO members have already become aware of urgency and complexities associated with the community solid waste problem. Furthermore, as an institutional planning body, MASCO will begin to work with the appropriate government agencies (described in subsequent sections) now actively engaged in the long range solid waste planning process.

Improvements to the Existing System

A study of MASCO member institution's solid waste practices by Benjamin Thompson & Associates (BTA) and Mr. Edward deMont (an expert on

solid waste management procedures) has recently been completed. Their detailed study has confirmed the general result of previous studies: that local environmental conditions associated with the existing, conventional trash storage and removal approach are generally satisfactory. (See the results of UE&C and ERT studies described in the preceding section.) The BTA-deMont study did indicate that the solid waste storage situation at some sites could be improved, at little financial cost and within a short period of time. Furthermore, by use of a coordinated pickup system and one contractor the number of truck trips could be substantially reduced. Appendix E contains a site by site listing of existing conditions and a summary of recommendations to improve various conditions at each of the existing trash storage pickup locations. These BTA-deMont data are the basis for the following description of system modifications.

Installation of Small Compactor Units Inside Buildings

Installing (14) small compactor units inside existing institutional buildings would result in trash volume reductions and allow storage of waste inside buildings and out of sight. This would result in improving aesthetic conditions and in eliminating parking-trash storage container conflicts. The before and after diagrams of Figures 4-2 and 4-3 illustrate the implementation details of this modification and suggest the environmental benefits which can be accomplished by its implementation.

New Rolloff Storage Facilities

Installing new concrete base pads with drainage connections (at 4 container sites) and new compactor equipment (at 15 container sites) will result in improvements in operator safety, sanitation, and in visual appearance of the rolloff storage facilities. In addition, standardization of rolloff storage containers is a requisite for a one contractor pickup system.

Central Control - One Contractor Pickup System

Establishment of a coordinated solid waste removal schedule for all MASCO member institutions will allow development of a pickup schedule

optimized to minimize both truck trips and contributions to traffic congestion. By eliminating the inefficiencies attendant with multiple contractors such as partial loads,* overlapping or crossing routes, and inefficient equipment, a significant reduction in trash truck trips can be accomplished. The BTA-duMont study indicates that the existing annual trash truck trip volume for MASCO institutions of 2,600 trips can be reduced by 39% to 1,586 trips for an annual reduction of 1,014 trips.

Corresponding future daily and annual trash truck trips, computed on the basis of this 39% reduction factor and future quantities of waste (presented in Section 4.2.2), are as follows:

	Year: Present	Year: 1980	Year: 1990
Trips/day	5	7	9
Trips/year	1,586	2,220	2,855

*The current practice is that institutions pay for container rental and for each truck trip.

4.2.4 Alternatives for Reducing Medical Area Solid Wastes

Introduction

Reducing the volume of wastes from MASCO member institutions has the potential to result in a number of potential benefits to the community. Depending on the particular methods of waste reduction which are employed, these benefits would include:

- Extending the life expectancy of municipal landfills as a result of weight and volume reductions achieved for the total municipal wastes stream;
- Decreased costs to the member institutions for routine replacement of disposable items, resulting in an ultimate economic benefit to users of these facilities;
- Reducing the degradation of environmental quality which results from the collection, transport and ultimate disposal of municipal solid wastes; and
- Reducing the energy consumption required for the collection, transport and ultimate disposal of municipal solid wastes.

Actual reduction of nonhazardous solid wastes generated by a hospital may be achieved in the following ways: (a) increasing the use of reusable items (i.e., switching from disposal to reusables, where possible), (b) on-site or off-site recycling of disposables or worn-out items, (c) decreasing the need for single-use or short-life products by more efficient housekeeping management techniques and by centralization of certain functions, (d) decreasing the need for single-use or short-life products by restricting their use, where possible. Although all of these general methods offer some potential for waste reduction, emphasis will be on the first two; namely, switching from disposables to reusables and recycling.

Increased Use of Reusable Items

Within the past decade, there has been a significant increase in the number of disposal or "single-use" hospital products. The most

prominent examples include plastic food service items (e.g., dishes and serving utensils), paper towels, surgical gowns and masks, uniforms, syringes, and some types of surgical supplies. The original reasons advanced for supplementing the corresponding durable-material items (e.g., china and metal utensils, cloth towels, etc.) with disposables were four-fold: (a) reducing the likelihood of cross-infection, (b) lower initial material costs, (c) decreased labor costs and (d) improved staff and patient morale. Recently, however, the uncontrolled use of disposables has come under review and, in many cases, discontinued by a number of institutions. The major reasons cited are

- Sterilization by means such as autoclaving, etc., is sufficient to eliminate the potential danger of cross-infection if properly implemented;
- The number of patients with communicable pathogenic diseases in a typical hospital in the 1970's is small. Such patients can be isolated and served from a limited supply of specially purchased single-use items;
- The use of disposable items generates large volumes of discarded contaminanted objects which pose internal waste management problems;
- Concern by hospitals that they may not necessarily be relieved of liability for the sterility of a commercially manufactured disposable unit; and
- Escalating costs of disposables, relative to the costs of cleaning and storing reusables.

It should be emphasized that the above represent problems experienced by hospitals relevant to their own specific areas of concern, apart from the much larger problems involved in community solid waste disposal.

Potential for Increased Use of Durables Among MASCO Member Institutions

A telephone check of MASCO member institutions (housekeeping unit executives) revealed that, on the whole, durable products were used for patient food utensils and linens (bedding, gowns, towels, etc.). The

latter are, in all cases, contracted out. Several institutions, however, use disposable items in staff cafeteria and snack bar areas; and, consequently, it is here that the maximum benefits are to be gained from switching to permanent products. Slight negative impacts on the municipal water supply would result from the increased washing required. Aside from the cafeteria, minor savings in material could be achieved by such measures as replacing paper towels in rest rooms with air dryers, use of burlap in place of plastic bags (or unlined containers) for non-contaminated wastes (e.g., groundskeeping and office paper wastes), use of longlife lighting elements and exercising a greater degree of selectivity in the purchase of material which must be periodically replaced (i.e., placing greater emphasis on the durability of a variety of hospital items).

Material Recycling of Hospital Wastes

Material recycling is defined in the context of this study to mean either the reuse of a product for a purpose other than the original one or the eventual reuse of its material components in the manufacture of a new end-product. An example of the former would be the use of a "tin" can as a receptacle for small, loose articles. An example of the latter is the reprocessing of the metal from such a can and the ultimate use of the reprocessed metal in the food packaging industry (original use) or in automobile components (new use).

It is necessary to discuss the short and longterm aspects of recycling from the on-site (front end) as well as the off-site viewpoint. In the limited amount of literature currently available, recycling is generally discussed in terms of (a) the separation (front end or municipally centralized) of solid wastes into "homogenous" materials and (b) processing and eventual recovery of material for which a potential market exists. The U. S. Environmental Protection Agency (EPA) in several recent publications has emphasized the need to ascertain the existence of potential markets in advance and the sustained capability of such markets to offset the high capital, operational and maintenance costs involved in source separation and material recovery.

On-Site Recycling

Currently, there are no cost effective means for homogenous material recovery on a scale as small as that of a single hospital, or even a group of institutions such as the ones served by MASCO. However, there are a number of nonhazardous items routinely discarded in a typical hospital which can be recycled on site to serve a function other than the original one. These items are generally reused on the hospital campus or taken home by institution employees. Such products can be recycled with a minimum of preparation and usually requiring only the normal cleaning or sterilization, if contaminated. Examples based on a program instituted at St. Louis Deaconess Hospital are listed in Table 4-6, along with the possible uses for the products recycled.* Because such items are classified as nonhazardous and are not, in general, sold to the public at large, the potential for adverse public reaction or legal challenge to the use of recycled goods of hospital origin is eliminated. Moreover, on-site manpower costs of frontend source separation will be minimized and manpower costs incurred in trash disposal will be reduced.

From Table 4-6, it is evident that some items can be effectively isolated from contamination within the hospital and thereby recycled, without preprocessing, for use either on site or in the community at large. Primarily these include office scrap paper and packaging material (cardboard boxes, excelsior, card, etc.), which can be removed at the loading dock and carted away.

Regional Recycling of Medical Area Wastes

The kind of recycling described above and in Table 4-6 constitutes, in essence, a simple, short-term method of decreasing hospital waste volume. Although an on-site recycling program such as the one instituted at St. Louis Deaconess would be a worthwhile undertaking, for MASCO institutions, reductions in the total volume of Boston's solid waste will, in all probability, be negligible due to the limited "market"

*Off-site paper recycling is included as a "short-term" alternative, since centralized paper recycling is in current operation in the Boston area.

for recycled products (i.e., the hospital and its employees). The next step, therefore, is to address the long-term potential for centralized off-site material recovery facilities (i.e., a metropolitan or regional plan for recycling) and the compatability of MASCO member institutions with such a plan.

The EPA has cautioned communities contemplating major investments in recycling plants that, at present, the capital expenditure and maintenance costs are high and markets tend to be volatile, varying with the basic material product and the geographical area. The agency has gone so far as to recommend that firm commitments (i.e., contracts) be secured from potential purchasers of the products of recovery systems before the initial capital outlays are made. In the long term, however, it is possible that continued research on recovery systems as well as the scarcity and steadily increasing costs of raw materials (i.e., diseconomies) could result in recycled metal, glass, paper, plastics, etc., becoming competetive with the corresponding material manufactured from the virgin stock. Current (1976) raw material prices are given in Table 4-7.

Apart from the difficulties in achieving economies of scale due to the lack of sufficient markets for the products of material recovery systems, there is the added problem of uncertainty as to the components, by weight, of the basic materials in the waste stream. Surveys to determine the composition, as well as its variability, are costly, and few cities have such inventories. EPA estimates for the nationwide mix, which is not necessarily indicative of the Boston area mix, are given in Table 4-7. The steps prerequisite to a a determination of the potential long term impact of the recycling of MASCO member solid wastes on municipal waste reduction are, thus,

1) identification of potential markets for basic recycled materials;

2) assessment of capital, operating and maintenance costs;

3) determination and periodic monitoring of basic material components in Boston's solid waste stream by responsible agencies;

4) determination of basic material components in the solid waste stream of MASCO institutions; and

5) assessment of the compatability of medical area solid wastes with regional markets and economics of scale estimated from (1), (2) and (3).

Establishment of a Solid Waste Inventory

It is immediately apparent that the participation of MASCO member institutions will be, for the most part, confined to the last two of the steps enumerated above. Although little has been done to date to quantify the components in the medical area's waste stream, the task is not insurmountable. Previous studies have yielded estimates of the types of products that can be expected to appear in the waste stream of a variety of hospitals. Probably the most comprehensive of these studies was the EPA sponsored Esco/Greenleaf Report on seven Los Angeles area hospitals.* This study classified disposal wastes into seven general categories: sharps (including needles and syringes), pathological/surgical, radiological, grindable garbage (primarily food waste), non-grindable garbage, rubbish (packaging, rags, waste paper and plastic, etc.) and noncombustible (glass, metal, ashes). Percentages by weight are given in Table 4-8 for the seven hospitals (range) and for the Los Angeles County-University of Southern California Medical Center (LAC-USC), a typical large urban multi-function teaching hospital. The first data column of Table 4-8 includes reusable patient items (e.g., linen, food service items, etc.).

The seven categories employed in the Esco/Greenleaf study were assigned mainly on the basis of the method of disposal and not from a recycling perspective. Large scale material recovery would necessitate a categorization, insofar as possible, by basic material constituent. This would require that some of the non-hazardous Esco/Greenleaf categories be subdivided; e.g., the general category "rubbish" would have the subclasses cardboard, paper products, plastic products, rags, yard wastes, etc. Because the bulk of items disposed are either single constituent (e.g., computer paper, rags, plastic drinking cups) or have easily separable constituents (e.g., old furniture, window screens), it should

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*Solid Waste Handling and Disposal in Multistory Buildings and Hospitals, prepared by Esco/Greenleaf for the U. S. EPA (Final Report SW-34d) (1972).

not be too difficult to make reasonable estimates of the components, by weight, of basic materials in a hospital waste stream. Such estimates are prerequisite to the establishment of routine procedures for front-end source separation.

Establishment of Front-End Source Separation

Once the hospital inventory, as described above, has been made and the institutions decide which waste products are to be disposed of and which are destined for an off-site resource recovery facility, front end separation procedures can be formulated. In general, the first step is to separate out those products which have virtually no chance of being contaminated while in use on hospital property. Examples of such items are packaging material discarded at the loading dock, office waste paper and computer printout paper, yard wastes, etc. These items are the least likely to arouse public concern or come into conflict with state or federal regulations. Furthermore, they present minimal logistics problems since they are ordinarily disposed of, initially, in isolated and distinct locations within the institution. The experience at Massachusetts General Hospital (MGH) is interesting in this regard.* MGH had plans five years ago to separate paper, cardboard, and glass materials. Labor costs to separate these materials generally exceeded their market values, and MGH has found that it is only feasible (at present) to separate corrugated cardboard. However, this amounts to a significant 15% (by weight) of MGH's solid waste.

Separation of discarded items by material constitutent can easily be accomplished by means of clearly marked containers in areas of the hospital which generate considerable volumes of mixed constituent trash; e.g., the cafeteria. For example, containers labeled "tin cans only" or "glass bottles only" can assist immeasurably in this regard, although it is anticipated that personnel would be assigned to check each such container prior to transporting it to the recycling center.

A potential problem associated with front-end separation is that of on-site storage. Depending on the frequency of deliveries to the regional reclamation center, a variety of difficulties may be encountered, such as

*Based upon ERT communication with Mr. Robert Rhodes of MGH on April 4, 1977.

proliferation of unsightly containers in hallways, offices, or food service areas or, in some cases, potential health hazards related to an accumulation of contaminated (although non-hazardous) wastes. Examples of the latter include such items as used drinking cups, paper towels, food residues and a variety of items from the rooms of noninfectious patients. Problems in this area can be reduced by such means as (a) sufficiently frequent transport to recycling centers (i.e., approaching the frequency of trash pickups) and (b) sterilization, isolation or freezing of potentially contaminated disposables. Either of these approaches is likely to be costly or even unwieldy, so that trade-offs between recycling and trash collection may have to be evaluated for different categories of solid waste.

Other Means of Hospital Waste Reduction

In addition to the increased use of disposables, on-site recycling and energy and material recovery, minor reductions in the hospital waste stream can be accomplished via such means as housekeeping and office management techniques or restricting those functions which tend to be "disposable intensive." Examples include the streamlining (and subsequent reduction in proliferation) of office forms, batch photocopying (as opposed to unrestricted use of photocopying machines), increased charges for individually packaged food items or even landscaping in such a manner that ground wastes are minimized while preserving outdoor aesthetics. Most of these are short-term approaches and their effectiveness would vary depending on the current housekeeping and office practices in each member institution. Moreover, trade-offs in terms of potential increases in manpower costs, reduced efficiency of institutional operations, or employee morale would have to be assessed.

4.2.5 Central Collection System Alternatives

Introduction

The use of various types of manual and automatic means of conveying trash from MASCO member institutions to a central point for processing and removal has the potential for producing the following benefits:

- reduction or elimination on local streets of noise, air pollution and congestion due to elimination of conventional trash trucks;
- reduction in trash truck trips; central collection point can serve as a transfer station where a single extra large 150 cubic yard (or larger) haulage truck would remove a day's waste production; and
- reduction of storage requirements at several of the institutions.

Manual System Employing Light-Duty Collection Vehicles

This system could consist of a collection scheme based upon use of light duty propane gas or electric powered tow vehicles which would collect loose (non-compacted) solid wastes. These vehicles would move within the medical area, supplying empty waste containers to institutions and removing filled containers. These containers would consist of small rubber tired trailers of approximately, 3 to 5 cubic yard capacity. A central transfer facility would be required were these containers to be emptied and automatically cleaned prior to returning to use. This central facility could compact the waste either with or without shreading and transfer the waste to large haulage trucks for removal from the area.

This approach would have the advantages of:

- providing quiet, non-air polluting collection within the medical area;
- reducing truck trips to and from the medical area;

- eliminating large storage containers within the medical area; and
- removing wastes from the institutions on a frequent basis.

On the other hand it would increase the activity of trash collection vehicles within the medical area and would require a special site, including adequate space to handle large vehicles, storage of waste and transfer equipment.

Automated Collection Systems

The objectives of an automated central waste collection system would be to consolidate the waste collection operations in the area, and to provide a clean, safe, and reliable method for conveying these wastes to a central location for processing and final disposal. The basic concept of such systems involves use of the utility distribution tunnels linking the MASCO member institutions with the Total Energy Plant.

Automatic collection systems have the following common advantages over conventional surface collection approaches since they would:

- produce no noise
- produce no air contaminants
- produce no traffic congestion
- produce no litter or other external sanitation or visual problems

Potential systems which were considered for this project included:

1) Centeralized Cart System
2) Mechanical Conveyors
3) Pneumatic Systems

A study of these systems by UE&C indicates that the following particular disadvantages exist:

Centralized Cart System Disadvantages

1) The cart system would require a substantially larger utility tunnel. In addition, large amounts of space would have to be provided at each institution and at a central location for cart storage, washing, and repair.

2) The installed cost for the system hardware alone would exceed 1.6 million dollars exclusive of the additional tunnel costs.

3) The system would be open and would present a potential fire hazard, an attraction for vermin, and would be subject to vandalism.

4) Cart systems have not yet been installed on a scale similar to the medical area. In those cases where systems have been installed, they have not been found to be an efficient and economical method for handling solid wastes alone.

Mechanical Conveyor System Disadvantages

1) Use of a belt conveyor for unclassified and nonhomogenious waste would require a minimum belt width of two feet. The approximate cost for such a conveyor installed could run as high as $500 per linear foot. A system consisting of some 5000 linear feet could cost $2,500,000 for the conveyor alone.

2) A belt conveyor installation would require a substantially larger utility tunnel. Space would have to be provided throughout the extent of the system to provide complete access to the conveyor for maintenance. Some piping could be run overhead; however, it would be physically impossible to run the large chilled water and steam lines in a tunnel similar in size to those presently being considered for the utilities distribution.

3) The belt conveyor would have to be enclosed, ventilated, and made rodentproof. In addition, the conveyor would require sprinklers along its entire length for fire protection.

Pneumatic System Disadvantages

1) The central collection system cannot be designed to handle all of the non-hazardous waste presently generated at the hospitals. Based on comparison of sizes of municipal wastes, it is possible that up to one-fourth of the daily tonnage of wastes may be unconveyable. Therefore, the installation of the system would not eliminate the need for all of refuse storage facilities which is presently in use. The amount of space allocated internally to waste disposal at each institution would be increased by the addition of the loading stations for each user, and this would result in an added housekeeping requirement.

2) The pneumatic system is subject to failure which historically is the result of human error, since operation of the system would require a certain level of competence.

3) There is no way of insuring that a pneumatic transport system would not suffer blockages. At best, one can only assume that these blockages may only require minimal system downtime of 3 to 4 hours.

4) The system would attempt to convey any object that is placed into its charging hopper. Therefore, it is possible that combustible and perhaps explosive material could, inadvertently or by sabotage, enter the system. These materials do not pose a significant problem to the transport system due to the fact that combustion could not take place during transport. There is a risk factor which would have to be considered if the material were to be transported to the power plant.

5) The system does not offer any reduction in labor for handling of solid wastes for the majority of its users. The exception to this is Affiliated Hospitals Center which has incorporated a central collection system as part of its design. Normally a vacuum system is installed to reduce labor costs by eliminating or minimizing vertical and horizontal transport of waste within a complex or high-rise building. By extending the

system to each floor or by interfacing the system with gravity chutes, it becomes advantageous to install a central system and reduce the manual handling and labor costs. For a few users, such as Children's Hospital and the Harvard Medical School, a system with only a single bulk loading station per user would definitely mean additional cost for sorting conveyable and unconveyable wastes and for hauling the conveyable waste through each complex to a single removal point.

6) From conversations with owners of pneumatic trash systems conducted by UE&C, ratings of the reliability have ranged from poor to excellent. In the cases where pneumatic conveying was endorsed, the owners did point out that initially there were "numerous problems" which had to be worked out of the system. In one case, two years was cited as the actual elapsed time period before the system performed to their satisfaction.

7) Due to the high daily waste load, the peak loading requirement and the limited number of refuse charging stations, it could become necessary to schedule system time for use by the institutions. Scheduling would limit institutional access to the system and may require alteration of housekeeping routines. The only exception to this would be the Affiliated Hospitals Center which must operate on a demand basis from a level sensor in their gravity chutes. A build-up of waste above the preset level in the chute would increase the potential for clogging and could result in malfunction of the chute system.

8) Increased construction impacts would be associated with the larger tunnels needed for the pneumatic system.

4.2.6 Regional Resource Recovery Facility Alternatives

Introduction

A possible long term alternative to the disposal of MASCO institutional solid waste would be in a Regional Resource Recovery Facility (RRRF). The basic concept of such facilities are to accept large quantities of solid waste from a number of municipalities and private source of solid waste and to process this waste, recovering both marketable materials (glass, metals, etc) and heat energy. The benefits would include the recovery of material and energy resources and a reduction of the load on land fills. For hospitals and related institutions regional resource recovery facilities appear to represent the ultimate long term alternative, especially when coupled with the "front end" approaches of programs to constrain excessive dependence on disposible items and to encourage appropriate separation and sale of high value, relatively easy-to-separate waste compounds such as corrugated cardboard. The following two sections discuss (1) some of the technical and economic considerations involved with RRRF and (2) status of government planning and encouragement of such facilities. In this latter regard it should be noted that as umbrella organizations such as MASCO develop experience and a concern with solid waste as a significant problem, they may look toward joint private sector-governmental planning and implementation ventures in the area of solid waste.

Future Potential for Large Scale Material Separation and Recovery

A description of state-of-the-art processes for material separation and recovery is beyond the scope of this study. Current technologies vary widely in ease of application, feasibility, and costs. Hand picking, the simplest means of material separation, is extremely labor intensive and does not attract conscientious workers. Hence, this method is uneconomical for large scale regional facilities. There are readily available and long established technologies for the pulping of used paper and for the mechanized separation and recovery of ferrous metals (magnetic separation and defining) and mixed color ("clear") glass. Technologies for most other basic materials are, however,

relatively new and await future refinements. The incentives to expend the effort in upgrading the processes of separation and recovery for these materials depend on such factors as available markets, an adequate supply in the waste stream to generate an economy of scale and the future supply of virgin materials. For example, in a 1971 report,* the EPA assessed the trade-offs in the recycling of plastics as being essentially negative due to the readily available supply of petroleum feedstocks for this commodity. Since that time, however, the cost of the virgin feedstock has risen considerably and the entire situation pertaining to the world's oil reserves has been subject to extensive re-evaluation. Thus it is a distinct possibility that recycled plastics could, at some future date, become competitive with plastics manufactured from the virgin stock.

Table 4-9 summarizes state-of-the-art procedures for material separation and recovery, along with the major advantages and disadvantages of each.

Future Potential for Energy Recovery

In the past few years, concerns over the rapid depletion of national and global fuel supply have provided the impetus for exploring the possibilities of deriving energy via the combustion and thermal reduction of solid waste. Energy recovery of solid waste has several advantages over material recovery. The major ones are enumerated below.

- Energy products can yield higher revenues per ton of waste processed than all other materials combined.
- A greater reduction of landfill requirements can be achieved through energy recovery than by recovering all other materials combined. Reductions of up to 80-90% of the waste input by volume have been estimated by the EPA.
- Reduction of the total pollutant burden on the atmosphere compared with municipal incineration and fossil fuel combustion.

*Drobny, N. L., Hull, H. E. and Testin, R. F., Recovery and Utilization of Municipal Solid Waste, Battelle Memorial Institute Report SW-10c prepared for the U. S. EPA Solid Waste Management Office (1971).

- Relative ease of site selection, compared with locating a site for a landfill or conventional incinerator.
- Less variability and unpredictability of potential markets, when compared with markets for recycled material products.
- Virtual elimination of the need, in most cases, for front end or terminal separation of waste materials. This is a particularly relevant factor in light of the above discussion of the particular problems associated with the on-site separation of materials in the hospital solid waste stream.

Balanced against these advantages, of course, are the relatively high capital expenditures and operational cost associated with technologies which are, in large measure, still in the developmental stage. Table 4-10 lists the technologies (along with the municipalities) currently in operation or expected to be in operation pending a successful shakedown. It will be noted that the two processes most commonly employed are waterwall incineration (heating and conversion to steam of water in hollow tubes enclosing a volume in which solid waste is burned) and the use of processed solid waste as a supplement to coal in utility boilers.

The major local facility for energy recovery is the waterwall incinerator in Saugus. This facility, which began operation in 1976, has a capacity of 1,200 tons of waste per day and is currently the largest of its kind in the nation. Steam generated at the plant is sold to General Electric. The facility is currently used by Beth Israel Hospital, accounting for about 10% of the total solid waste burden of the eight MASCO member institutions. A much smaller (240 ton) waterwall incinerator has been operating in Braintree since 1971.

Governmental Planning in the Area of Solid Waste

Current long range planning efforts, by Federal, State and local governmental agencies, in the area of regional solid waste disposal appears to be directed toward regional resource recovery facilities. A number of governmental agencies such as the U. S. Environmental Protection

Agency,[a] the Massachusetts Bureau of Solid Waste,[b] (under the Executive Office of Environmental Affairs) and Boston Department of Public Works have either issued regulations or policy statements emphasizing the critical need for regional cooperation and use of large scale resource recovery facilities as the best long range approach to solid waste disposal. A large scale for such facilities is considered important to be able to achieve satisfactory rates of energy and materials recovery and to establish attractive capital and operating economics. This does not preclude the fact that incineration and heat recovery at smaller facilities may also be consistent with regional solid waste disposal plans; however, the trend appears to favor larger scale facilities.

The Massachusetts Bureau of Solid Waste Disposal under the Executive Office of Environmental Affairs is responsible for coordinating and implementing solid waste disposal planning efforts in Massachusetts. The Bureau has a solid waste plan for the Northeast Region. The Northeast Region includes the cities and towns listed in Table 4-11. Current plans for the Northeast Region call for the construction of a 3,000 ton per day resource recovery water wall incinerator-generator by 1981. (Ref. 1) This incinerator-generator is to be privately sponsored and operated and will generate steam and produce power to be sold to New England Electric Company. Additionally, there are markets in the Northeast Region for recyclables from the planned facility. Contracts for the purchase of recyclable material have already been signed to take effect when the incinerator-generator becomes operational. A suitable site for this facility was recently rejected by the town of Haverhill and potential sites are currently being evaluated in Tewksbury, Methuen, Amesbury, and North Andover.

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[a] The wording in the "Resource Conservation and Recovery Act of 1976," promulgated October 21, 1976 suggests that the Federal government will be placing a series of increasingly tougher standards on landfill operations (in terms of controlling dust emissions and leachates for example).

[b] The director of the Bureau of Solid Waste, in interpreting the results of a State sponsored A. D. Little study of resource recovery for the state, indicated that the state favors a strong involvement of the private sector with the regional resource recovery approach: "We believe that private industry, with its technology and financing ability, has got to get into resource recovery for it to be successful." Boston Evening Globe, March 31, 1974 page 38.

Planning for solid waste disposal in the Western Region in the Boston area is currently being undertaken. The Western Region has not as yet been clearly defined on a city and town basis as has been the Northeast Region. It is expected that this region will include most of Middlesex County, portions of Norfolk County (Norfolk has its own solid waste plan) and Suffolk County. Suffolk County (Boston) is particularly important to the Western Region if an incinerator-generator similar to the one planned for the Northeast Region is to be implemented. The amount of solid waste generated by Suffolk County is needed to make such an incinerator-generator economically feasible. Planning for an incinerator-generator in the Western Region has not occurred as expenditiously as in the Northeast Region for reasons including the following:

- Some of the Western Region suburbs already have incinerators for solid waste (including Waltham, Framingham, Brookline (transfer station), Wellesley).
- Landfill costs in this region are still relatively cheap at \$1-\$2/Ton.
- Markets for recyclables have not as yet been well established in the Western Region.

The City of Boston currently disposes of its solid wastes at the Gardiner Street Landfill in West Roxbury and at other landfill sites outside of the city including one in Plainville. Boston currently has no definitive plan for waste volume reduction and has not as yet made a commitment to the Western Region project discussed above. An official at the Boston Public Works Department, however, has stated that Boston's long range concept of solid waste management will probably include involvement in a large scale incinerator-generator effort. (Ref. 2)

The U. S. Environmental Protection Agency through the Solid Waste Disposal Act seeks to encourage regional areas to develop solid waste management plans by using federal grant incentives. The EPA is currently formulating the expected content of a regional solid waste management plan. The EPA particularly seeks to encourage the development of regional solid waste management plans which are currently underway. A spokesperson at the EPA Region 1 office has stated the EPA considers

the Northeast Regional project (which involves an incinerator-generator and resource recovery) to be well underway and that the western regional plan is progressing at a reasonable pace. (Ref. 3) EPA recognizes that Boston's landfill situation will become less favorable as available landfill sites become more scarce and EPA favors the involvement of Boston in a Western Regional incinerator generation and resource recovery project.

The overall concept of solid waste management on a regional basis as per the plans being developed and implemented for the Northeast Region and the Western Region call for large regional incinerator-generators coupled with resource recovery in which recyclables are sold to the private sector. The planned incinerator-generator concept requires a dependable supply of large volumes of solid waste in order to be economically feasible and thus requires the cooperation of the municipalities involved. The implementation of an incinerator-generator concept will result in waste volume reduction in Eastern Massachusetts and will decrease the future demand for landfills in an area where available landfill space is at a premium.

The MASCO membership is a large organization which generates a significant amount at solid waste. It is highly likely that MASCO will eventually be involved in a regional solid waste plan of the type described above. Front end recycling at MASCO, as describe in Section 4., represents a relatively short term approach to solid waste volume reduction. Major progress in solid waste disposal and waste volume reduction will required regional approaches. It is also likely that the form in which solid waste can be received at planned regional resource recovery facilities will be determined by special requirements of the facility. Thus, detailed planning and implementation of complex front and recycling schemes may represent a transitory approach to waste volume reduction.

REFERENCES

1. ERT Telephone Communication 7 & 8 April 1977, with John Griffith, Bureau of Solid Waste Disposal, Division of Environmental Quality Engineering, Massachusetts Executive Office of Environmental Affairs.

2. ERT Telephone communication, 12 November 1977 with Joseph Casazza, Commissioner, Public Works Department, City of Boston.

3. ERT Telephone communication, 7 April 1977, with Ira Leighton Solid Waste, Radiation, and Noise Branch, Environmental Protection Agency, Region I Office.

TABLE 4-1

EMISSIONS OF AIR CONTAMINANTS THAT WOULD BE AVOIDED IF INCINERATION WERE ELIMINATED FROM THE TOTAL ENERGY PLANT[a]

Emission Rates and Emissions as Presented in the Final[b] Environmental Impact Report

	lb/ton of refuse	lb/hour based on burning 14 tons during a 17 hour period	lb/year based on burning 4,470 tons
SO_2	2.5	2.0	12,410
NO_2	2	1.6	9,930
Particulates			
with no collection equipment	15	12.4	76,942
with a cyclone having collection efficiency of 50%	7.5	6.2	38,471

Emission Rates and Emissions Based on Current Designs of an Incinerator System[c]

	lb/ton of refuse	lb/hour based on burning 39 tons during a 17 hour period[d]	lb/year based on burning 12,325 tons[d]
SO_2	1.5	3.4	18,488
NO_2	10	22.9	123,250
Particulates			
with secondary chamber after burning and no additional collection equipment	1.4	3.2	17,255
with a cyclone having collection efficiency of 42%	0.81	1.9	9,983
with a scrubber having a collection efficiency of 80%	0.28	0.6	3,451
with an electrostatic precipitator having a collection efficiency of 86%	0.20	0.5	2,465
Carbon Monoxide	negligible	negligible	negligible

[a]Supplement No. 5 for Compilation of Air Pollutant Emission Factor - Second Edition, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, December 1975.

[b]Emissions factors are based on industrial/commercial single chamber incinerators.

[c]Emission factors are based on controlled air incinerators.

[d]Solid waste tonnages are based on estimates for the year 1980. It has been assumed that all solid waste generated would be burned.

Note: Emissions of other contaminants such as organic acids associated with incineration have not been included since they are dependent upon types and quantities of materials burned.

TABLE 4-2

SELECTED CHARACTERISTICS OF MASCO ALTERNATIVE SOLID WASTE SYSTEMS

(Note: For ease of comparison, table is based upon current waste production rate; see text for future solid waste production rates.)

Alternative	Percent of Solid Waste Recycled (%)	Solid Waste to Landfills		Trash Truck Trips	
		Tons/day[1]	Tons/year	Trips/day[1]	Trips/year
Pneumatic Collection and Incineration (to be removed per proposed action)					
Final EIR Estimate	80[2]	3	880	3.3	1,040
Latest Estimate	60[3]	11	3,496	3.3	1,040
Existing Conventional Truck/Landfill					
Final EIR Estimate	-	14	4,420	17.3	5,200
Latest Estimate[4]	-[4]	28	8,740	8.3	2,600
Improved Conventional Truck/Landfill					
BTA-de Mont Estimate	-[4]	28[4]	8,740[4]	5.1	1.586[5]
Resource Recovery Alternatives					
MGH Extrapolation	15[6]	24[6]	7,429[6]	8.3	2,600
Centralized Collection Alternatives					
Transfer Station Approach[7]	-	28	8,740	1.0	310
Regional Resource Recovery Facility					
Current Technology[8]	85	4	1,311	8.3	2,600

FOOTNOTES FOR TABLE 4-2

1. Based upon a six-day week.

2. In the September 29, 1975, FEIR, no allowance was made for non-conveyables, and it was assumed that incineration would consume 80% of the solid waste (by weight). All solid waste consumed would be recycled to heat energy required for steam generation.

3. Based upon UE&C estimates that 25% of all waste will be unconveyable and require separate handling (and is assumed here not to fit into incinerator operation). Of the conveyable waste, only 80% would be consumed in the incinerator. Base quantities of waste and trash quantities from ERT survey (see text). All solid waste consumed would be recycled to heat energy required for steam generation.

4. Based upon ERT survey of actual trash pickup practices (see text). There may be isolated instances of office and/or computer paper recycling. See Appendix A.

5. Based upon a study by Benjamin Thompson & Associates and Edward de Mont, solid waste consultant.

6. As noted in the text, there is no MASCO specific data to make a good estimate of the real potential for recycling for the MASCO members. In the absence of such data, the recent experience of Massachusetts General Hospital was used as an illustration. At MGH, 15% by weight of solid waste is cardboard which is removed by different truck (same number of average truck trips is assumed).

7. This assumes that one extra large (150 cubic yards) transfer truck removes an entire days' solid waste production.

8. Current technology figures range between 80 to 90% effective in "recovery rate" (see text).

SUMMARY OF MASCO MEMBERS' SOLID WASTE STORAGE AND REMOVAL APPROACHES

		Storage Characteristics		Removal Characteristics[9]		
Institution	Location	Container Type[5]	Container Size (Cubic Yards)	Frequency Days	Weekly Total Pickups	Time Of Pickup
N. E. Deaconess	Alley connecting Autumn St. & Joslin Road	C	40	Once a day (Mon. - Sat.)	6	9 AM
	Autumn St. & Joslin Road	D	8	On Call Typically twice a	2 (9)	-
	Alley Next to Cancer Research Building	D	8	On Call week pickup	2	-
Joslin Clinic	---None[1]---					
Beth Israel	On Emergency Entrance Road Northeast side of property	C	35	Three times (MWF) & On Call (Tue.)	3 to 4	7 - 9 AM
Sidney Farber Cancer Inst.						
Jimmy Fund Bldg.		C	10	Once a day (Mon-Sat)	6	7 - 8 AM
C. A. Dana Bldg.		C	30	Once every 2 days[6]	3	Morning Afternoon or Evening
Redstone Bldg.	(2)	D	6	Once a day (Mon-Sat)	5[2]	-
Peter Bent Brigham	Shattuck St.	C	30	Once a day	6	11 - 1 PM
Children's Hospital	300 Longwood	C	40	Once every 2 days & on call (Tue., Thur., Sat.)	3 - 4	7 AM
	Enders	C	30	On Call	1	-
	Enders	D	6	Once a day	6	6 - 7 AM
	Judge Baker[3]	D	6	On Call Typically	1	-
	Garage	D	6	On Call once a week	1 (9)	-
	55 Shattuck	D	6	On Call pickup	1	-
Mass College of Pharmacy	Loading Dock (rear (rear of White Bldg.)	D	10[4]	Twice a week (Wed & Sat)	2	2 - 3 PM Wed. 8 - 9 AM Sat.
Boston Hospital for Women (BLI)	Rear of Hospital (NE wall)	C	30	Once every two days (Mon., Wed., Fri.)	3	9 - 10 AM
Harvard Medical School	Medical School Pkg. Lot	C	40	Once a week	1	Midday
	Medical School Pkg. Lot	D	3[7]	Once a day		
	Medical School Pkg. Lot	D	6	Once a day		
	Dental School	B	2[8]	Once a day		
	SPH #2	B	15[8]	Once a day	6[9]	Midday
	SPH # 2 Kresge	D	4[7]	Once a day		
	Countway	B	10[8]	Once a day		
	LHRRB	D	6[7]	Once a day		
	Vanderbilt	B	15[8]	Once a day		

Footnotes on next page.

FOOTNOTES FOR TABLE 4-3

1) Joslin Clinic has an arrangement with N. E. Deaconess wherein they use the Deaconess 40 yard compactor unit. Furthermore, Joslin did not make plans for a conventional (compactor or dumpster) pickup facility in the design of their new facility which is almost completed.

2) The Redstone building is not completely operational and plans for solid waste disposal have not been made yet. A best estimate was used for near term future storage and removal characteristics was used to complete this table.

3) Children's Hospital occupies space in the Judge Baker Guidance Center Building and uses a dumpster there, but Children's is not responsible for disposal of this waste.

4) This waste consists of compacted bags loaded into a dumpster unit. This particular bag compactor results in a 6:1 compaction factor on loose waste material.

5) Three types of solid waste storage containers are used by MASCO member institutions; "C" denotes on-site compactor and storage box, "D" denotes open steel box or dumpster and "B" denotes plastic bagged trash.

6) Pick-up not regularly scheduled but "on call" basis.

7) Two identical units, each of the indicated capacity, are generally at this location.

8) Cubic yards of loose waste were determined from numbers of bags by using an estimate of 2 bags per cubic yard.

9) Refer to Appendix A, page 39 for proceedure used to estimate trash truck trips. Note, a single contractor and compactor truck service N.E. Deaconess Hospital, Children's Hospital and Harvard Medical Schools, making a single daily loop truck trip.

TABLE 4-4

EXISTING CONVENTIONAL SOLID WASTE SYSTEM;
PRESENT AND PROJECTED FUTURE WASTE QUANTITIES
AND TRUCK TRIPS

	Year: Present		Year: 1980†	Year: 1990†
Quantity of Solid Waste	Final EIR*	Recent Studies** Range		
Tons/day	14	26-28	40	50
Tons/year	4,420	8,112-8,740	12,316	15,626
Truck Trips				
Trips/day	17	6-8	12	15
Trips/year	5,200	1,820-2,600	3,664	4,649

*As presented in Final EIR dated September 29, 1975.

**Range of estimates by United Engineers & Constructors, Inc., Charles Hilgenhurst and Associates, and Environmental Research & Technology, Inc.

†Based upon ERT estimates for present year (maximum values indicated) and UE&C derived projection factors for increases in solid waste.

TABLE 4-5

EMISSIONS FROM LIGHT AND HEAVY DUTY MOTOR VEHICLES

Emissions from Light Duty Vehicles (grams/mile)[a]

	5 mph	10 mph	20 mph	30 mph
Carbon Monoxide	128.8	78.5	42.9	27.4
Hycrocarbons	9.4	5.8	4.3	3.2
Nitrogen Oxides	4.0	3.8	3.7	4.0
Particulates (from exhaust)	0.34	0.34	0.34	0.34

Emissions from Heavy Duty Diesel Vehicles (grams/mile)[b]

	5 mph	10 mph	20 mph	30 mph
Carbon Monoxide	34.2	30.4	25.3	15.5
Hydrocarbons	7.4	5.5	4.3	3.3
Nitrogen Oxides	29.8	23.6	22.0	25.1
Particulates (from exhaust)	1.3	1.3	1.3	1.3

[a]Emissions for light duty vehicles are based on a composite car in 1977.

[b]Emissions for heavy duty diesel vehicles are based on a composite truck prior to 1973.

Source: Preliminary Edition of Supplement 5 to Compilation of Air Pollutant Emission Factors, AP-42, U. S. Environmental Protection Agency, 1975.

Note: All speeds represent a composite average speed, taken over a driving cycle which consists of cruise, idle, acceleration and deceleration modes.

TABLE 4-6

TYPICAL HOSPITAL SOLID WASTE PRODUCTS AND POTENTIAL FRONT-END RECYCLING USES*

Item	Major Potential Uses
Paper	
Cartons, cardboard boxes	O.U., H.U.P., drawer and shelf lining, resale by student nurses
Computer printout/cards	Community paper drives, scratch pads
Adding machine tape	Fire starters
Office forms	Scratch pads, re-use of snap-out carbon
Discarded photocopy paper	O.U., H.U.P., community paper drives, scratch pads
Plastic	
Bottles (Saline and formulan)	O.U., H.U.P. (home wine-making, general purpose)
Urinals	Brush recepticals on cleaning carts
Basins/bedpans	Photographic tanks, H.U.P.
Medicine bottles	O.U., H.U.P.
Funnels	O.U., H.U.P., ornaments
Drinking glasses	Re-use in psychiatric ward
Metal	
"Tin cans"	Planters, receptacles for grease & small loose items
Stainless steel instruments	H.U.P.
Old pipes, isotape "cows"	Melted into shielding bricks for radioactive material
Aluminum foil	O.U., H.U.P.
Organic	
Kitchen scraps (from produce	Guinea pig and rabbit food
Outdated blood	Nitrogen enrichment of soil
Coffee grounds	Home composting, soil ameloration, worm cultivation (for fishing bait)
Glass	
Bottles (general)	O.U., H.U.P.
Bottles (1000 milliliter)	Containers for photographic materials
Bottles (dark glass medicine)	Containers for light-sensitive photographic materials
Fabric	
Sheets and pillowcases	Pieces used to make drawsheets, shredding for insulation or packaging material
Towels, washcloths	Shredding for insulation or packaging material, laundry sacks (pillow cases)
Carpet scraps	Insulation or packaging material (esp. sound insulation for teletypes).

TABLE 4-6 (Continued)

TYPICAL HOSPITAL SOLID WASTE PRODUCTS AND POTENTIAL RECYCLING USES*

Item	Major Potential Uses
Miscellaneous	
Carpenter shop sawdust	H.U.P. (compo st)
Miscellaneous packaging material	O.U., insulation
Window screens	Compost molds, H.U.P.
Hemostats	H.U.P., ("de-hookers" for fishing equipment
Extra doors or tables	H.U.P., desktops, temporary walkways in areas of construction activity
Steel drums (55 gallons)	Trash barrels, re-cycle containers, H.U.P.
Surplus sales (sold via sealed bids)	Examples include old furniture, bassinettes recreational equipment, electrical applianc grounds equipment, etc.

*Exclusive of recycling at centralized off-site facilities.

O.U.: Original use (if normally discarded prior to wearing out)

H.U.P: Home use by hospital personnel.

TABLE 4-7

CURRENT VALUE AND PERCENTAGE COMPOSITION OF THE TYPICAL MUNICIPAL WASTE STREAM OF MAJOR RECYCLABLE MATERIALS

Material	1976 Cost (Dollars by Ton)	Percentage by Weight of Municipal Solid Wastes
Paper	15**	30-35
Ferrous Metal	12-20	7-9
Aluminum	200+	<1
Glass	12-20	6-10
Plastics	Variable	1*
Rubber	Variable	0.5-1.5*
Fabric	Variable	NA
Food wastes	-	
Yard wastes	-	

*1971 figures

**Approximate average for newsprint, higher for most other grades

NA - Not available

TABLE 4-8

DISTRIBUTION OF SOLID WASTES IN SEVEN LOS ANGELES COUNTY HOSPITALS
(FROM U. S. EPA ESCO/GREENLEAF REPORT)

Type of Waste	Percent by Weight		
	Seven Hospitals (% Total Wastes)	LAC-USC Medical Center[c] % Total	LAC-USC Medical Center[c] % Disposables
Sharps, Needles, etc.	0.1-0.2	0.1	0.3
Pathological/Surgical	0.0-2.4	1.3	4.4
Soiled Linen[r]	45-63	58.6	-
Rubbish[a]	9-26	20.9	70.1
Reusable Patient Care Items[r]	*	*	-
Noncombustibles	1.2-4.4	1.8	6.0
Garbage (nongrindable)[b]	2.3-4.5	2.3	7.7
Food Service Items[r]	10-22	11.6	-
Radiological	*	*	*
Food Waste	3.4-14.9	3.4	11.4

*Trace (<0.1%)

[a] Packaging, rags, cloth, bedding, products of grounds maintenance, etc.

[b] Primarily nongrindable food wastes.

[c] A major urban teaching hospital (3,000 beds).

[r] Reusable items.

TABLE 4-9

ADVANTAGES AND DISADVANTAGES OF RECOVERY TECHNIQUES FOR MAJOR MATERIAL CONSTITUENTS*

Type of Recovery	Advantages	Disadvantages
Handpicking (all materials)	Small capital investment, wide range of materials, easy to control	Labor intensive, costly, employee hazards, limited to bulky or easily separable objects
Compositing (biodegradable components)	Readily available technologies, low costs	Lack of viable markets in the U. S. in general and in eastern New England in particular.
Paper fiber recovery (wet and dry separation)	Depend on price of low-grade paper, which fluctuates widely	Developing technologies, limited marketability, low quality product.
Ferrous metal recovery	Readily available technology, tin and copper are valuable commodities which can be extracted	Shredder may have to be adopted to the specific market (esp. copper precipitation or de-tinning) to minimize technical problems downstream.
Aluminum recovery	Very valuable commodity	Uncertain Technology
Glass recovery	Cullet requires less fuel than virgin materials, color-sorted cullet relatively valuable	Market for mixed color ("clear") glass near saturation, color sorting economically infeasible at present
Plastics recovery	Thermoplastics easy to re-form, alleviate potential long term scarcity in the event of petroleum feedstock depletion	Virgin materials are currently readily available and relatively cheap, technological problems, (particularly with composites), uncertain quality of end-product, prohibitions of use uf re-cycled plastics in food packaging
Fabric Recovery	Depends on future markets	Very limited market at present (roofing and fine writing paper), problems in separating natural and synthetic fibers, problems in separating out contaminated cloth
Rubber Recovery	Several technologies readily available, reclaimed rubber is easier to masticate and fill than virgin rubber, quality constraints are not to severe	Markets and price tend to fluctuate, markets are specialized (primarily confined to the auto industry)

*Sources: (1) Levy, S. J. and Rigo, H. G., Resource Recovery Plant Implementation (Technologies), U. S. EPA Report SW-157.2 (1976); (2) Decision-Makers Guide in Solid Waste Management, U. S. EPA Report SW-500 (1976).

TABLE 4-10

LOCATION AND STATUS OF ENERGY RECOVERY SYSTEMS
BY TECHNOLOGY TYPE AND ENERGY PRODUCT, 1975*

Technology	Energy Product				
	Electricity	Steam (other than for generating electricity)	Solid fuel (other than for producting steam or electricity)	Gaseous Fuel	Liquid Fuel
Waterwall incineration:		Braintree, Mass[b]	N.A.	N.A.	N.A.
		Nashville, Tenn.[b]	N.A.	N.A.	N.A.
		Saugus, Mass[d]	N.A.	N.A.	N.A.
	Hempstead, N. Y.[e]	Hamilton, Ontario[b]	N.A.	N.A.	N.A.
Processing for use as supplemental fuel for boilers	St. Louis[b] Ames, Iowa[d] Bridgeport, Conn[d] Chicago[d] Milwaukee[e] Monroe Co., N.Y.[e] New Britain, Conn.[e]		Palmer Township, Pa[e]	N.A.	N.A.
Pyrolysis		Baltimore[c]		South Charleston, W. Va.[b]	San Diego[d]
Methane recovery:	Los Angeles[a][b][f]		N.A	Los Angeles[a][b][f] Mountain View, Calif.[a]	
			N.A.	Pompano Beach Fla[a][g]	
Direct combustion/ gas turbine	Menlo Park, Calif[a][c]	N.A	N.A.	N.A.	N.A.

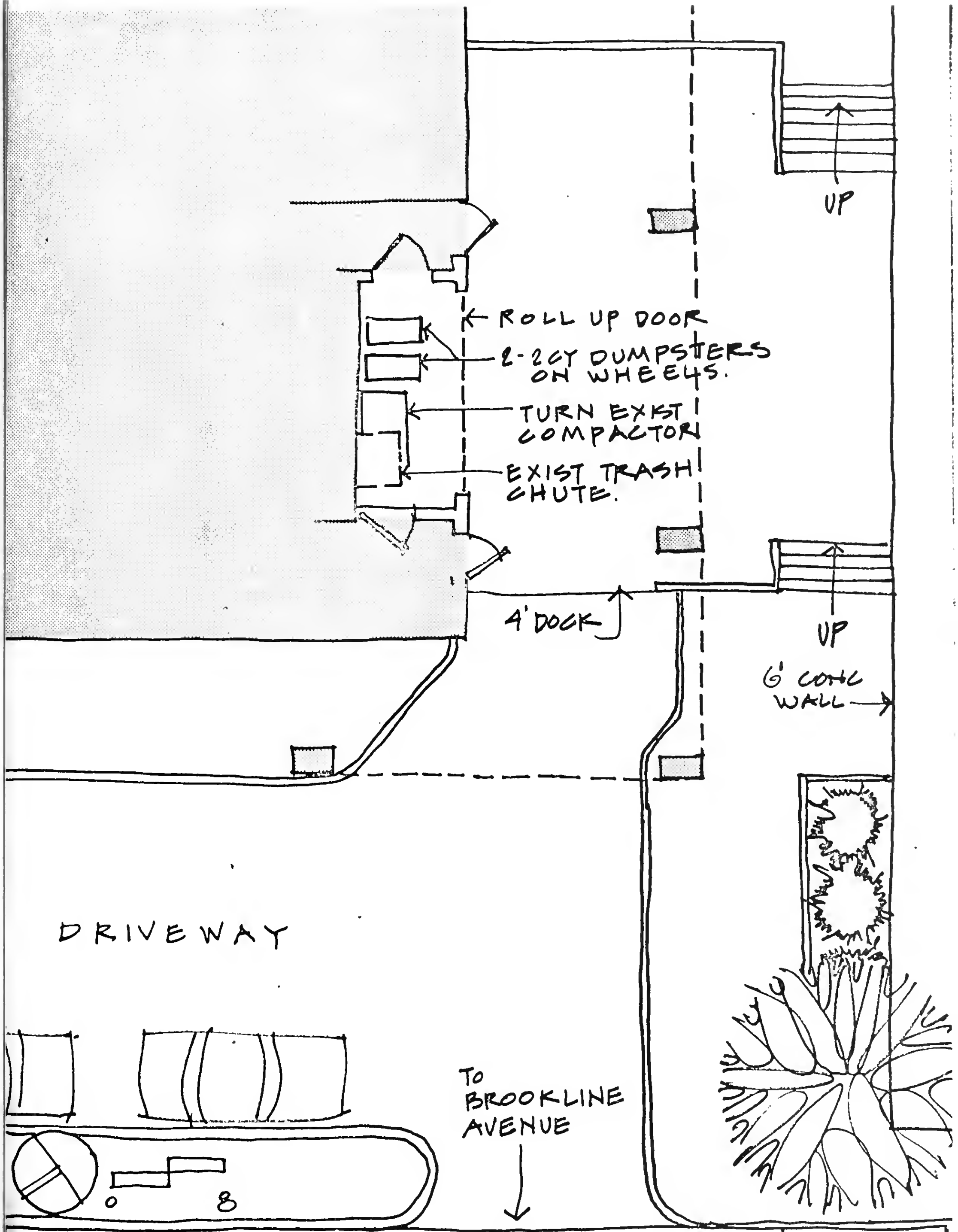
[a]Research or experimental operations.
[b]System in operation.
[c]In shakedown.
[d]Under construction.
[e]Construction not yet started, but system has been selected.
[f]From sanitary landfills.
[g]Controlled bacterial digestion in an anaerobic tank.

TABLE 4-11

CITIES AND TOWNS INCLUDED IN THE
NORTHEAST REGION

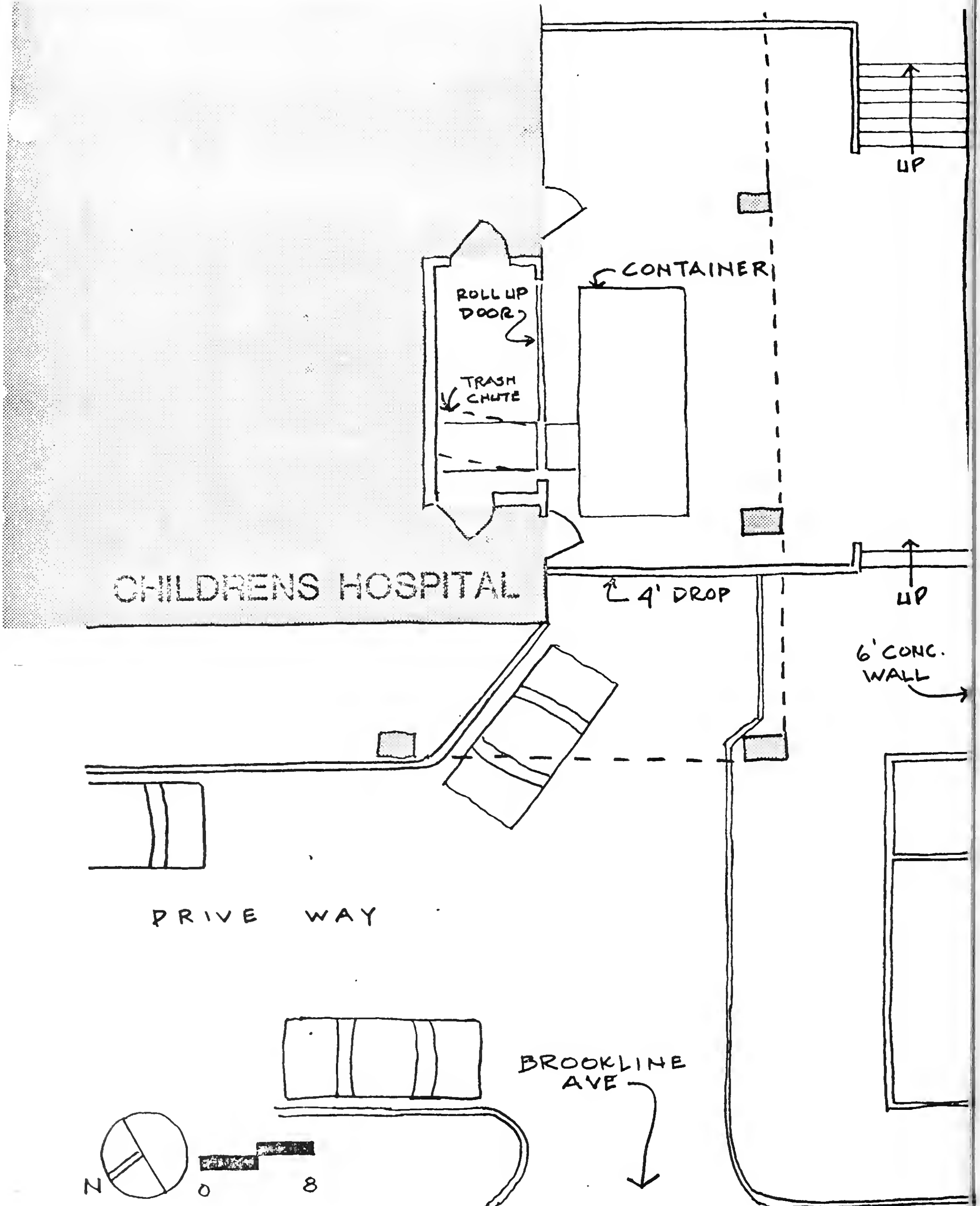
Andover, Haverhill, Lawrence, Methuen, North Andover, Amesbury, Bedford, Beverly, Boxford, Brookline, Carlisle, Chelmsford, Danvers, Dracut, Essex, Georgetown, Gloucester, Groveland, Hamilton, Ipswich, Lowell, Lynn, Lynnfield, Manchester, Marblehead, Merrimack, Middletown, Nahant, Newbury, Newburyport, North Reading, Peabody, Reading, Rockport, Powley, Salem, Salisbury, Swampscott, Tewksbury, Topsfield, Tyngsboro, Wenham, Westford, West Newbury, Wilmington, Woburn. In New Hampshire: Atkins, Derry, Pelham, Plaistown, Salem, Windham

Figure 4-1 Existing Solid Waste Container Locations



PROPOSED/ CHILDRENS HOSPITAL 5

FIGURE 4-3



EXISTING / CHILDRENS HOSPITAL

FIGURE 4-2

5.0 DEVIATION FROM CITY OF BOSTON NOISE REGULATIONS

5.1 Discussion of Boston Regulations

The original 121A application and the Environmental Impact Statement stated that MATEP would meet all applicable codes and regulations including "Regulations for the Control of Noise in the City of Boston". The Regulations define numerical octave band sound level requirements at zoning lot lines in Regulation 3. These requirements can be summarized by the Single Number Equivalent (dB(A)) as follows:

	1		2		3	4
Category Zone and Use	Residential Zoning District or Residential or Institutional Use Elsewhere in Conformance with Boston Zoning Code		As Category 1 In Any Industrial District		Business Zoning District Other Than Residential or Institutional Use in Conformance with Boston Zoning Code	Industrial Zoning District Lot in Residential or Business Use in Conformance with Boston Noise Code
Time	Day	Night	Day	Night	Any Time	Any Time
dB(A) Limit	60	50	65	55	65	70

Literal interpretation of the above would require that MATEP conform to a radiated noise at adjacent lot lines of the octave band sound levels equivalent to 60 dBA during the day (7 AM to 6 PM) and 50 dB(A) during the night (6 PM to 7 AM). Commitments to these limits were made in good faith and were based on preliminary inputs from vendors of cooling towers which are the major noise source resulting from operation of MATEP. During the detailed design phase of the project it became apparent that it was not technically feasible for MATEP to meet the literal requirements of Regulation 3 and still operate without risking plant performance, reliability, or capacity.

Permission is requested to deviate from the literal requirements of Regulation 3 for the Control of Noise in the City of Boston. To determine the significance of this request, it is necessary to examine the Regulations and their intent.

The intent of the Regulations is to provide the required tool for acheiving the difficult, but desirable goal of improving, and then maintaining, the noise environment of the City of Boston. Regulation 2 (General Prohibition of Noise Emissions) states that:

> No person or persons owning, leasing, or controlling the operation of any source or sources of noise shall willfully, negligently, or through failure to provide necessary equipment or facilities or to take necessary precautions, permit the establishment or continuation of noise pollution.

Regulation 1 defines the noise pollution as follows:

1.4 NOISE POLLUTION means the presence of that amount of acoustic energy for that period of time necessary:

a) to cause temporary or permanent hearing loss in persons exposed;

b) to otherwise be injurious, or tend to be, on the basis of current information, injurious to the public health or welfare;

c) to cause a nuisance;

d) to interfere with the comfortable enjoyment of life and property or the conduct of business; or

e) to exceed standards or restrictions established herein or pursuant to the granting of any permit by the Commission.

As a definitive noise code, the Regulations must provide numerical values which can be legally applied to all situations as the definition of noise pollution required in 1.4(e) above. As presented in Section 5-1, Regulation 3 defines these numerical values.

A deviation is requested only from the specific numerical requirements

for a night-time level of 50 dBA in a residential zoned area. To determine the significance of a deviation from Regulation 3, an analysis is provided based upon a fundamental work on the response of a community to noise by Stevens, Rosenblith and Bolt (Ref. 8) (Attached as Appendix F).

5.2 Description of the Environment

5.2.1 General Characteristics of Community Noise

The sounds normally present in a given environment are defined as the ambient sound level. These sounds may emanate from man-made as well as natural sources. Whether these sounds are considered to be noise depends upon the loudness, duration, quantity, and quality of the sounds as well as the source, the listener, and the interrelationships between the source and listener.

Since the normal response to noise is generally based upon the existing ambient sound levels, the ambient levels must be well defined. The sounds contributing to the ambient sound level are subject to fluctuation and may vary according to the time of day (day, evening, night), time of week (weekday, weekend), and time of year (summer-foliate season, winter-defoliate season).

The MATEP site is in a highly urban area composed of hospitals and medical support institutions, with commercial/business properties along Brookline Avenue, and residential three and four story houses along Francis Street. Plans for the proposed service center call for the removal of these houses (now owned by Harvard) directly opposite the MATEP site along Francis Street (see Figure 5-1). The ambient noise levels for this site are dominated by the heavy vehicular traffic along Brookline Avenue and Francis Street. The ambient sound levels in the environs of the MATEP site continue to be affected by traffic well into the early morning hours. Noise from roof-mounted cooling towers of the existing Harvard power plant located on Childrens Road affects the ambient sound levels in the general vicinity (see page 5-10 and Section 5.4). Other roof-mounted ventilation and cooling equipment located on buildings in proximity to the MATEP site contribute at times to the ambient

sound levels realized by the community. As will be discussed later the lowest ambient in proximity to the MATEP site already exceeds the Boston night-time residential code of 50 dBA. Therefore it is deemed appropriate that any new noise source must be evaluated in terms of an intruding level on the lowest measured residual ambient.

5.2.2 Existing Sources of Noises

5.2.2.1 Data Collection and Analysis

The ambient sound levels were measured using instrumentation and procedures that conform to the standards promulgated by the American National Standards Institute. Equipment used is described in Paragraph 5.2.2.3. Sound is measured in arbitrary units of decibels (a mathematical logarithmic value of a ratio) referenced to a standard sound level of 20 micro Pascals* (μ Pa) which is the approximate threshold of hearing for a young adult. To describe a sound, one must consider both the frequency and magnitude of the sound. To assess the frequency content of the sound, a standard approach is to use a frequency weighting (A network) which approximates a response of the human ear. This value is called the dBA sound level and has a good correlation with a person's subjective evaluation of the loudness of a sound. Table 5-1 presents the dBA value of common sounds. Another more detailed approach for measuring the frequency content of a sound is to measure that part of the sound that occurs in different parts of the audible frequency range. The American National Standards Institute has standardized the basic frequency division into octave bands, two to one frequency range ratios, which are defined by the center frequency of the band. The center frequency of these standard bands are 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000, 16,000 cycles per second (Hertz).

*20 μ pa = 2 x 10^{-5} N/m^2 = 0.0002 bar = 20 x 10^{-6} N/m^2 = 0.0002 $dynes/cm^2$

The magnitude of a sound is usually a random function since sound often varies considerably in level. Several approaches are used to measure the magnitude of sound. Standard sound level meters measure the short term (0.2 and 0.5 seconds) average energy equivalent of the sound wave. This is called the rms (root means square) value. Since the maximum average time of 0.5 seconds is short compared to the time of the typical variations of community sounds, techniques have been developed to further quantify the magnitude of sound. A common approach to measuring ambient sound levels for the purpose of assessing a community's response to a new sound is to measure the residual sound level which is the most common minimum of a sound (ignoring occasional dips in the sound). This approach has historically been used to assess community response. Another approach is to measure the sound level that is exceeded a given percentage of the time which is the Lx level, where x is the percent time that the sound level is exceeded. Several commonly used Lx descriptors of community noise are the L90 level which approximates residual level, the L50 level which approximates the average level, and the L10 level which approximates the common peak level. Also used is the peak sound level which defines the maximum sound level that occurs. A new approach that is being offered for consideration is the Leq level which is the long term rms level. This descriptor has a disadvantage in that it emphasises the high sound levels that may only occur rarely.

Care was taken during the measurements to ensure that the weather conditions did not bias the measured data. Due to the significant influence of local traffic on the ambient sound levels of the area, no measurements were made when the road pavements were wet, thus avoiding any increase in sound level resulting from the noise of tires on wet pavement. Observations of the area during many visits indicated that it was experiencing normal community activities during the periods of measurements, i.e., no major road construction,

special events, etc., were in progress. Sufficient data were collected to obtain representative ambient sound levels for the area.

Sites were visited at random times, consistent with acceptable meteorological conditions. All measurements were taken with the microphone held four to five feet above the ground and at least 12 feet from the nearest building or significant vertical reflecting surface.

The ambient noise levels measured (in sound pressure level, dB, re 20 μ Pa) are summarized in Table 5-2 and are presented in detail in Tables 5-3 through 5-16. The magnitude descriptors measured include the maximum sound levels, along with the L50 and L90 sound levels. The frequency measurements include the "A" weighted sound level (dBA) and the octave band sound levels at preferred center frequencies.

There is no current consensus on the best magnitude descriptor of community noise. Historically, a measure of community noise has been considered to be the residual or background noise. The residual noise level, the most frequently observed minimum noise level, is currently being defined as equivalent to the L90 or L95 level. The ANSI method(1) asks for a determination of the central tendency which can be equated to the median or L50 level. The U.S. Department of Housing and Urban Development (2) defines their "Acceptable" and "Discretionary-Normally Acceptable" levels in terms of a level which is exceeded less than 8 hours/day, i.e., the L33 level. The Federal Highway Administration (3) evaluated the noise from highways in terms of the L10 level, but also states that the L50 level is the "typical" value of noise at a given point. The U.S. Environmental Protection Agency (EPA) recently proposed the energy mean level (Leq) as a measure of community noise,(4) EPA comments have recently been presented that Leq can be approximated by the L10 level; however, in Ref. 3, it is demonstrated that for highway noise, the energy mean

(Leq) is between the L10 and L50 levels and is closer to the L50 level. The L01 and L99 levels have also been used to describe community noise. As seen from the above cited examples, there are several interpretations of what is the best descriptor of community noise. The residual level (most common minimum) represents a conservative assessment for the ambient noise level and is used by the Commonwealth of Massachusetts to define the ambient. The Commonwealth of Massachusetts' regulations state that an approval for a facility will be granted if the installation or modification of the noise source does not:

(1) Increase the broadband noise level in excess or 10 dB (using the residual level in dBA defined as the L90 level) above ambient; or

(2) Produce a pure tone condition.

In assessing the ambient sound levels and the resultant impact thereon, the residual ambient sound level is used. This presents the lowest descriptor of the ambient sound levels and therefore the greatest potential impact.

5.2.2.2 Personnel

The measuring and evaluation of the community ambient noise levels were done under the supervision of Basil A. Bonk, Acoustical Supervisor for United Engineers & Constructors Inc. (Massachusetts Professional Engineer Registration No. 28132).

5.2.2.3 Instrumentation

The instrumentation used in all the measurements consisted of General Radio Type 1933 Precision Sound Level Analyzers serial numbers 396 and 2629, meeting both the requirements of ANSI S1.4[5] for a Type I instrument and requirements of IEC 123[6] and IEC 179 [7]. A General Radio 15/16 inch ceramic

microphone was used with the instrument. The instrumentation was calibrated before and after each measuring period using a General Radio Type 1562A Sound Level Calibrator, serial number 7120, in accordance with the manufacturer's instructions. These calibrators were calibrated by the General Radio Company within six months preceeding the time of all measurements. The status of the batteries in the instrument was checked prior to and after each measurement period. To eliminate the effect of any wind-generated noise bias, all measurements were performed using a 3 inch diameter, open cell polyurethane foam windscreen. This windscreen reduces wind effect on a microphone by greater than 20 dB, allowing outdoor measurements to be made with wind speeds of up to approximately 20 miles per hour; however, to be conservative, measurements were not taken at wind speeds exceeding 10 miles per hour or when it was judged that wind fluctuations were influencing the measured sound levels. The use of the windscreen does not affect the accuracy of the instrumentation.

5.2.2.4 Selection of Measuring Locations

Measuring locations were selected to be representative of the noise sources in the environs of the MATEP site as well as other locations which are not influenced by specific sources of noise to allow a determination of the critical ambient noise level in the environs of the proposed site. Figure 5-2 presents the location of the measurement locations selected to represent the ambient sound levels in the area of the MATEP site. Measurement points 3, 4, and 5 were chosen so as to measure the sound levels associated with the operation of the unsilenced cooling towers of the existing power plant. Levels measured at points 3, 4, and 5 were not considered in the selection of the design noise criteria for the proposed plant. Measurements at points 1, 2, and 6 were chosen so as to measure the ambient sound levels realized by the abutters of the proposed plant. It should be noted that, although the existing

cooling towers are slightly audible at point 6, the shielding provided by the Jimmy Fund building is sufficient so that the levels measured at point 6 are reasonable representations of levels which would be experienced if the cooling towers were not operating. This assumption was validated in March, 1977 when the load demand of the existing plant permitted the expensive and difficult shutdown of the cooling towers of the existing plant. Measurements taken at point 2 are representative of the sound level produced by the traffic along Brookline Avenue. Measurements taken at point 1 are representative of the ambient sound levels realized by the residential houses along Francis Street. Measurements were conducted at night on four different occasions at point 1. During two occasions the cooling towers of the existing plant were slightly audible, but the measured sound levels are identical to those measured during the other two occasions. On these occasions the cooling tower noise was not audible to two trained acoustical observers. It can be concluded, therefore, that the levels measured at point 1 during all four night measurements are true ambient levels, and that these levels are not affected by operation of the existing cooling towers. As discussed for point 6, this assumption was validated during the March survey. Due to traffic noise associated with Brookline Avenue and Francis Street, point 1 is not the lowest ambient in the area, but it is considered the most critical noise boundary ambient. Measurements taken at point 7 are also representative of the sound levels realized along Francis Street. Measurements recorded at point 8 are also considered critical in determining a design criterion. In the early morning hours there is no measurable traffic noise, and the area was observed to be surprising quiet for an urban environment. Because of the low measured levels, point 8 was also used to determine the design facility noise boundary criteria. Measurements recorded at point 9 are influenced by traffic along the Jamaica Way which continues throughout the night. Measurements

taken at point 10, located in Joslin Park, are representative of the minimum ambients that can be expected in the hospital areas in the morning hours, when traffic becomes light on Brookline Avenue. Points 11, 12 and 13 are representative of the only three tall buildings in the general vicinity of the proposed plant that are able to open their windows. The other tall buildings in the area are sealed.

5.2.2.5 Data Summary

The data from the ambient sound level surveys conducted in the environs of the proposed plant are presented in Tables 5-3 through 5-16. For each measuring location, the date and time of each measurement are recorded, along with the noise sources observed during the time of each measurement. The levels consist of the maximum, minimum, and L50 and L90 sound levels, measured in dBA, and the sound levels at preferred center frequencies as required by the Commonwealth of Massachusetts' regulations. The minimum measured residual noise level at the site boundaries at street level was 51.5 dBA (Point 1). For elevated receptors in this area, the minimum residual noise level would be at least 1.5 dB higher due to a greater exposure to traffic noise and roof-mounted mechanical equipment. (At a twenty-six story high elevation, the minimum residual noise level was 3 dB higher than that occurring at street level.) Generally, residual ambient levels in proximity of the MATEP site at street level approach 53 dBA at night, 55 dBA during the evening period and approach 60 dBA during the daytime.

Table 5-17 presents the meteorological conditions experienced during the surveys (i.e., wind speed, wind direction, relative humidity, and temperature).

5.2.3. Critical Receptors

The land parcels in proximity to the proposed MATEP site are in the process of further development. To predict the noise impact on the community due to operation of the MATEP facility it is necessary to consider the proposed receptors presently planned for the environs of the MATEP site as well as present receptors which will remain after initial operation of the plant. The parcel of land along Francis Street in proximity to the proposed site presently consists of 3 and 4 story residential homes. These residential homes will be replaced by the new service center presently planned for this site. The service center will consist of a parking garage, warehouse, and some office space to be operated by MASCO for the use of the medical institutions in the area. The homes on Francis Street past the intersection of Binney Street will remain. The two critical receptors selected to determine the noise impact along Francis Street are the top floor of the proposed new service center and the nearest residential home which will remain after initial operation of the plant.

The parcel of land along Binney Street in proximity to the proposed site is presently under construction. The Affiliated Hospital Center (AHC) under construction at this site will consist of four 200 foot towers set back from both Binney and Francis Streets and a parking facility along Binney and Francis Streets. The critical point on AHC was determined to be the top floor of the tower closest to Binney Street due to the fact that at this elevated receptor both the contribution of stack and plant radiated noise will be maximized. The AHC towers will have sealed windows.

Both the service center and the Affiliated Hospital Center are designed to incorporate off street parking which will help alleviate any congestion due to additional traffic in the area associated with the operation of the hospital center. The only sources of noise anticipated for these new developments would be the operation of some type of HVAC equipment.

Since MATEP would be providing these facilities with electricity, steam and chilled water, any required HVAC equipment is not anticipated to contribute to the ambient noise levels presently being realized in the area.

The parcel of land along the former Peabody Street presently consists of the Redstone Laboratory, which breeds animals used for medical research. The windows of this building abutting MATEP have been sealed both internally and externally with the initiation of construction of the proposed facility. Also along this former street is the Frederika Home, a facility for the elderly. The top floor of the Frederika Home was determined to be a critical receptor. Although no significant impact on the Frederika Home will be realized from operation of the proposed facility, a post operational survey will be conducted by the Applicant and corrective acoustical treatment will be pursued if necessary to avoid an adverse impact. This treatment could include interior sound panels or the sealing of the building.

The remaining parcels of land in proximity to the proposed site along Brookline Avenue presently consists of a gas station and a few retail businesses. Along Fenwood Road, an area approximately 400 feet south of the proposed site, the lowest residual ambient noise level was measured. A critical receptor was selected on the top floor of the Massachusetts Mental Health Center located at this point. There are residential homes along Fenwood Road further east of the Mental Health Center but it was determined that the Mental Health Center would be more appropriate for determining the maximum noise impact since the homes are a greater distance from the proposed plant, they will experience a lower level of radiated noise. The above selected receptors represent the most critical receptors in the environs of the MATEP facility (see Figure 5-1).

5.3 Description of the Proposed Noise Design Program

5.3.1 Introduction

Noise impact on the surrounding community due to operation of a proposed facility may be judged with reference to two criteria. First, one must consider projected noise levels and their relationship to relevant standards or regulations. A second measure of impact is the change in noise level above the existing ambient, which results from the planned development. This latter type of measure is deemed appropriate where the preservation of the existing residual noise levels in a community is essential for the area to continue to serve its intended purpose. Both types of impact have been investigated for the proposed MATEP facility.

If a planned development causes an increase in the existing ambient noise levels in the community, even though the projected noise levels are within the statutory maximum levels, an intrusion or impact at sensitive receptors abutting the proposed development can occur. As discussed in Section 5.2, the existing residual ambient noise levels already exceed the prescribed maximum levels adopted by the City of Boston Air Pollution Control Commission. It is appropriate, therefore, that a realistic assessment of impact should be based on the quantitative increase above existing community residual noise levels. As discussed in Section 5.4.4 empirical studies have shown that people begin to respond to changes in noise level of approximately 5 dB. Thus, changes in noise levels less than this may be considered insignificant.

Massachusetts guidelines allow a maximum increase in broadband noise level of 10 dB above the existing background, in dBA, with the provision that a pure tone condition does not exist.

As discussed in Section 5.4.1, for the proposed facility the design noise criteria of 60 dBA at the noise boundary lines (defined on Figure 5-3) will result in no significant impact at any of the abutter's lot lines and will comply with the Massachusetts guidelines.

The Applicant has chosen a design noise criteria based on full operation at ultimate capacity of the facility. Actual noise levels realized at the noise boundary lines of the proposed facility will be somewhat lower during the initial proposed utilization of the plant. This is demonstrated by the table in Section 5.4.2. Although acceptance for only the initial facility is being pursued, the acoustic design presented herein is predicated on the full operation of the final facility. Engineering and economic considerations dictate this approach in order that the criteria can still be met with potential expansion.

5.3.2 Noise Sources

The following noise sources present during facility operation have been identified as contributing to the noise levels which will be realized by the community at the boundary of the facility.

(1) Cooling Towers

(2) HVAC Equipment

(3) Precipitators

(4) Stack

(5) In-Plant Noise Levels Transmitted Through Building Enclosure

(6) Boiler Steam Cleaning

(7) Relief Valves

The major noise contribution radiated to the community for a facility of this type is the operation of cooling towers. The silenced cooling tower design

of the proposed plant will result in a smaller zone of impact than the cooling towers of the existing plant. Further, the operation of MATEP can be expected to lower the residual ambient noise levels in certain areas of the community because the existing power plant on Childrens Road will be decommissioned, thereby significantly lowering noise levels in its vicinity as much as 10-20 dB (discussed in Section 5.4.3).

All of the noise sources identified as contributing to the community ambient noise level due to operation of the proposed facility are examined in detail in the succeeding paragraphs.

5.3.2.1 Cooling Towers

As will be discussed in Section 5.5 the intial design goal was to incorporate a cooling tower design which could meet a noise criterion of 50 dBA at the noise boundary lines of the proposed plant and conform to the octave band requirements of the Boston Noise Code.

Discussion with major cooling tower vendors established that neither the Boston Noise Code, in octave bands, nor a 50 dBA level could be obtained, and that a level in the approximate mid-50's dBA represented the lowest level obtainable with a proven cooling tower design utilizing proven components.

UE&C conducted field evaluations on a similar type cooling tower as that proposed for the MATEP plant and designed a silencing system with the objective of achieving the lowest possible noise level within the specified constraints of the plant. The lowest level that could be achieved within the various design constraints with adequate engineering certainty was approximately 56 dBA. A necessary 2 dB design factor was added to the specified sound levels expected from the towers to assure conservatism in the predicted levels radiated to the community. This resulted in the specified 57-58 dBA cooling tower noise boundary criterion used to calculate community impacts

and establishes the noise level budget for the balance of the facility to meet a proposed noise criteria. Allowing 57-58 dBA for the cooling towers, limits the attainable noise criteria for the total plant to 60 dBA

Although the 57-58 dBA cooling tower design criteria required the attenuating of both the air intake and discharge of the towers at a cost penalty approaching $5 million and a fan horsepower penalty for six cooling tower cells of approximately 860 hp, the design goal is being pursued to yield an acceptable and appropriate noise level. According to available information, this proposed cooling tower silencing concept represents the only installation of this size and type in the world which incorporates sound attenuators on both the air intakes and discharges of the individual cells. It should be noted that using the lowest cooling tower design level of 57-58 dBA necessitated silencing all other plant noise sources as much as possible to meet the lowest possible total design noise criterion of 60 dBA.

5.3.2.2 Heating, Ventilating, Air Conditioning (HVAC) Equipment

All HVAC intakes and exhausts will incorporate sound attenuators and/or other acoustical treatment as required to meet the total design noise criterion of 60 dBA (requiring HVAC silencing to approximately 49 dBA) at the noise boundary lines of the facility. The HVAC fans are being sized with significant additional horsepower and cost penalties to allow silencers to be installed.

5.3.2.3 Precipitators

The significant noise generated from the operation of electrostatic precipitators is associated with the hopper vibrators and plate rappers. The precipitator hoppers (and their vibrators) have been located below the roof of the plant, so the noise from this source will be isolated from the community due to the transmission loss design of the building. The plate rappers of the

precipitators have been specified to be silenced by the vendor to a level not to exceed 47 dBA at the noise boundary lines of the facility. This is an attainable criterion based on prior experience.

5.3.2.4 Stack

The noise radiating from the stack of the proposed facility will be due to the exhaust noise of the diesels. Although the final equipment vendor has not been selected for the thermal afterburners and heat recovery steam generators to be incorporated in the operation of the plant, it is expected from available data that a sufficient degree of attenuation will result. The degree of attenuation provided by the heat recovery steam generators and associated ductwork should guarantee that the contribution of stack noise at the noise boundary lines of the facility or beyond will not increase the total plant operation noise above the 60 dBA design criteria below an elevation of 200 feet above ground. Analysis of the area by the Applicant's design consultants indicates that the 200 foot elevation at the noise boundary lines of the facility is a reasonable estimate of the highest ultimate development height for those land parcels abutting the proposed facility. To maintain a conservative analysis, it was assumed that the sound levels on the noise boundary lines at a height approximately equivalent to the height of the stack may exceed 60 dBA. However, the noise radiating from the stack will not cause the sound levels resulting from operation of the proposed facility to exceed the 60 dBA criteria at any receptor in the environs of the facility, including proposed developments at all abutter's lot lines due to distance and directivity attenuation. The increase in sound level resulting from the operation of the facility (including the stack) at the area on Fenwood Road (which represents the lowest ambient sound level measured in the environs of the site (42 dBA)) will be less than 6 dB on a worst-case basis.

For the emergency/maintenance diesel exhaust by-pass system, which would not be attenuated by the thermal afterburners and heat recovery steam generators, silencers will be installed as required in the by-pass ducts to the stack, so that stack-radiated noise will not exceed the design criteria of 60 dBA below the 200 foot elevation at the noise boundary lines.

5.3.2.5 In-Plant Noise Levels Transmitted Through Building Enclosure

The noise radiated through the exterior plant walls of the facility is primarily due to noise from the diesels and chillers, the major sources of in-plant noise. Most exterior walls of the proposed facility will consist of a 4-inch course of brick with a minimum air space of 3 inches and an interior wythe of 6 or 8-inch lightweight cement block having an approximate 0.4 average absorption coefficient.

All windows will be of the acoustical sealed type with a specified transmission loss. The diesel and chiller areas of the facility will incorporate acoustical roof decking or equivalent sound panels to provide an approximate 0.65 absorption coefficient. The resultant noise radiated from the building enclosure will not exceed 49 dBA at any exterior surface.

5.3.2.6 Boiler Steam Cleaning

The boiler steam cleaning will consist of a series of short interval steam releases. The steam cleaning is a one-time event required before the initial operation of the facility. A temporary silencer will be installed during the initial steam blowdown of the facility to guarantee that sound levels will not exceed 90 dBA at the noise boundary lines of the facility. To further mitigate the impact in the community the steam blows will be scheduled only during weekdays from 8 AM to 4:30 PM and the surrounding neighborhood will be duly notified.

5.3.2.7 Relief Valve

All boilers will be provided with power-operated relief valves which will incorporate silencers resulting in levels that will not exceed 90 dBA at the noise boundary lines. These relief valves are set at a lower trip release than the coded safety relief valves used to relieve pressure in an emergency. The power-operated relief valves should minimize, if not eliminate, the tripping of the safety relief valves. Power-operated relief valves are being used because silencing of the coded boiler safety relief valves is not good engineering practice due to safety considerations. In a meteorological environment such as Boston, there is no vent silencer available that could be absolutely guaranteed not to clog. To further minimize the tripping of the safety valves, the proposed plant combustion management will employ a sophisticated combustion control system. If there is an unexpected safety valve steam release, the release would only last a few minutes. Although the noise would be startling to the surrounding community, the noise level is not sufficient to cause hearing damage since the duration of the noise level is so brief. It must be emphasized, however, that with the dual relief system and the sophisticated combustion control system the release of coded safety valves is highly unlikely. Should other vent reliefs pose a community noise problem following operation, they will be silenced as required. This is proposed because there is no reliable method of predicting the resultant noise.

5.3.3 Pure Tones

The noise radiated from MATEP is anticipated to be non-tonal. As previously discussed, the silenced cooling towers are the dominant noise source that will be perceived by the community. As stated, UE&C field evaluated the noise from similar sized cooling towers. The intake noise is due almost entirely to the sound of falling water with a resultant frequency spectrum that is quite uniform with frequency. This noise source can be validly described

as random and non-tonal. The discharge noise of the tower was measured at both a point elevated above the fan discharge cone and at the rim of the fan discharge cone with the following results:

		Octave Bands and Sound Levels in dBA 2×10^{-5} N/m^2								
Discharge	dBA	31.5	63	125	250	500	1K	2K	4K	8K
Elevated	81.9	83.2	87.5	85.8	81.2	79	76	74	70	65
At Rim	81	77.3	75.5	74	75.8	74.8	75.7	74.7	72.5	68.9

This tower had an eight bladed fan operating at approximately 125 rpm for a resultant blade passage frequency of 16.67 Hz. As can be seen from the data, there was no evidence of a tonal characteristic in the 31.5 hZ octave band which would be influenced by the blade passage frequency and would contain the second harmonic. Further, no audible tone was evident to the field observers. Because of the stringent silencing requirements imposed on the cooling towers, it can be reasonable anticipated that the cooling tower vendors will have to limit the fan tip speed and control the fan selection for a low noise type of blade (wide chord blade). Both these measures would tend to eliminate the production of an audible dominant fan tone. Further eliminating the potential of a dominant fan tone is the fact that water noise is a significant contributor to the discharge noise. In summary, the cooling towers should result in a non-tonal noise. Another major noise source is the diesels. The intake and casing noise would have a dominant tone at the turbocharger inlet compressor blade passage frequency. These sources are contained within the building enclosure and will be reduced by the plant walls to about 49 dBA at the building exterior. The diesel exhaust noise would be tonal at the firing frequency. This source radiates to the community via the exhaust path to the top of the stack. The large number of

ductwork bends and particularly the turbulence introduced by the firing of the particulate afterburner will eliminate the tone from the radiated noise. For the HVAC fans, the source sound power level of each fan was increased by 5 dB in the octave band containing the blade passage frequency prior to being silenced to the criteria. This has the effect of masking the fan tone of the silenced result by the broadband noise due to air turbulence. Further, the variable pitch vane axial supply fans that will be used for the HVAC system will be limited to a minimum operation of about 60% of design value. This maintains the fan at efficient operating points where tone dominance is usually not a problem. Dominant fan tones for this type of fan usually occur when the fans are operated at points remote from the optimum efficiency point.

5.4 Impact of the Proposed Action

5.4.1 Proposed Noise Design Criteria

The proposed noise design criterion of 60 dBA at the noise boundary lines to a height of 200 feet above grade represents the very lowest criterion that can be reliably proposed for MATEP. Section 5.3 describes this criterion in detail and Section 5.6 discusses the reasons why further improvements cannot be realized.

The use of this criterion requires permission to deviate from the literal requirements of portions of the Regulations for the Control of Noise in the City of Boston. Specifically, permission to deviate from the requirements of the Regulation's nighttime and Sunday residential single number equivalent level of 50 dBA and the applicable octave band levels of the Regulations is required. Neither of these deviations will result in any significant noise impact to the community. Nor would the granting of the deviations mean that any actual receptors would experience a 10 dB increase in ambient levels. High ambients which already exist in the area and predictions of MATEP contributions at actual receptors result in a worst-case increase of 5-6 dB and a normal increase below 5 dB. Sections 5.4.2, 5.4.3 and 5.4.4. demonstrate that the intent of the Regulations is satisfied. MATEP's noise contributions are compatible with and will not significantly change the existing ambient noise characteristics of the area.

The design criterion of 60 dBA is within the Massachusetts Noise Guidelines which permit an increase of 10 dB over the ambient with no pure tones. At actual receptor points MATEP will increase the ambient 5-6 dB on a worst-case basis. MATEP will produce no pure tones.

5.4.2 Predicted Noise Levels on Critical Receptors

A worst-case determination of impact is based upon the results of ambient noise surveys conducted at thirteen points in the area during eleven different time periods including four periods at night. These surveys show that the lowest existing ambient residual sound level at the noise boundary line is 51.5 dBA which occurred at street level. At higher elevations the ambient noise levels were observed to be higher due to increased exposure to existing noise sources such as traffic and roof-mounted mechanical equipment. Measurements taken at 3-story heights show that the ambient increased 1.5 dB due to greater exposure to traffic noise and roof-mounted mechanical equipment. Measurements at a building approaching 26 stories showed that the ambient increased 3 dB. The lowest residual noise level measured in the general environs of MATEP was 42.0 dBA measured on one night at a point on Fenwood Road. These lowest measured ambient residual sound levels (51.5 dBA and 42 dBA) were utilized as the basis for conservative design. It should be noted that observations of the area show that traffic noise which continues throughout the night will cause frequent noise level excursions significantly higher than either the lowest residual levels measured or the predicted levels resulting from operation of the MATEP plant. For urban areas such as the environs of the MATEP plant, various federal agencies would use descriptors of the ambient noise level which would yield higher values as cited in the DEQE permit, thereby significantly reducing the stated impact.

The conservative ambient levels were used in conjunction with calculated worst-case and expected normal operation plant noise contributions using one feasible method of cooling tower silencing to determine the sound levels that will be perceived by existing or proposed critical receptors. This analysis is summarized as follows:

CRITICAL RECEPTOR	PRE-MATEP EXISTING AMBIENT	POST-MATEP WORST-CASE PREDICTED LEVELS*	POST-MATEP NORMAL OPERATION PREDICTED LEVELS*
Affiliated Hospital Center - top floor (under construction on the corner of Binney and Francis Streets)	54.5	56.6	55.7
Proposed Service Center - top floor (Planned for Francis Street across from MATEP)	53.0	58.9	57.8
Mental Health Center - top floor (Fenwood Road - area of lowest residual sound levels in environs)	43.5	48.8	47.7
Three story residential home - top floor (On Francis Street opposite Binney Street - closest residential property after proposed Service Center is constructed.)	53.0	58.0	57.1
Frederika Home - top floor (Peabody Street - Binney Street)	53.0	58.8	57.7

*(Noise radiated from MATEP (combined radiated and existing low ambient.)

All calculated predictions at critical receptors were performed at the face of the outside wall of the receptor. The actual noise levels from MATEP perceived by a person inside a room with an open window at the critical receptors would actually be much less depending on their position in the room. According to the Environmental Protection Agency (Ref. 4) the approximate national average of sound level reduction due to attenuation by the exterior shell of a house would be 15 dB with the windows open. The result from MATEP is an interior sound level below 45 dBA, a level which is clearly "Acceptable" according to HUD criteria[2].

It should be noted that the minimum residual measured at Francis Street on one occasion was the minimum residual used for all receptors in

proximity to the proposed plant. Therefore, the impacts projected represent a maximum upper bound.

5.4.3 Retirement of the Existing Power Plant

The ambient noise levels measured in the immediate vicinity of the existing power plant range from 71 to 80 dBA depending upon cooling load. The ambient levels in this immediate area (which includes the Jimmy Fund Building, the Dana Cancer Research Center, and parts of the Childrens Hospital complex) will be below 60 dBA when the existing plant is retired and MATEP operating. The existing plant would contribute about 61 dBA to the ambient at the top of the proposed Affiliated Hospital Center, while MATEP will contribute about 52 dBA to the same point. This net reduction in noise levels at certain critical receptors in the area must be a factor for consideration when determining MATEP's noise impact.

5.4.4 Expected Community Response

The generally accepted methodology used for the prediction of community response to a new noise source is that developed by Stevens, Rosenblith, and Bolt[8]. Their methodology, originally based upon twenty case histories, uses various categories of community response versus noise ratings. Figure 5-4 presents an adaptation of the original scheme developed. The prediction method focuses on how the community is expected to be impacted since it is difficult to predict how any one person will respond to a noise stimulus. This method or a minor variant thereof (with many additional case histories) forms the basis of the state-of-the-art approach to assessing community noise impact.

When predicting impact from a new noise source many factors must be considered. These include the following:

(1) Existing Ambient Noise Levels

The existing ambient noise levels in the MATEP area are discussed in detail in Section 5.2. The impact resulting from MATEP must be analyzed using the ambient noise level as the reference for comparison. The area around the plant might, at best, be characterized from a noise viewpoint as a residential urban area rather than a hospital zone. Actually, the noise resulting from high traffic levels and the considerable amounts of mechanical equipment necessary to the institutions in the area really indicates that receptors have adapted to noise levels higher than might be expected in a residential urban area. Regardless of the fact that this is a hospital area, it cannot be considered as a "quiet hospital zone." It is readily apparent from the history of the area that the community does not consider existing mechanical noise sources causing greater noise levels than MATEP to be intrusions. (MASCO and the DEQE have no records of any noise complaints associated with operation of these sources.) On this basis, a noise level increase in this area would be expected to have significantly less impact than the same increase might have in a suburban or truly residential urban area.

(2) Temporal Factors

Operation of a noise source during only a certain fraction of the time each day will tend to decrease the impact from that source. Although MATEP's noise levels will be relatively continuous, the higher worst-case levels of noise expected from the plant will almost always occur during

the daytime when cooling requirements and utility demands are highest. Noise levels from the plant will be at a minimum during the more sensitive nighttime hours. This characteristic decrease will help to further minimize the impact of the plant. (Although a nighttime decrease is anticipated due to the projected load requirements, no commitment can be made because MATEP is required to provide the critical services as demanded.)

(3) Description of the Noise

A noise spectrum that includes audible pure tone or single-frequency components is usually judged to cause more impact than a spectrum that is more continuous. Additionally, a noise that is reasonably continuous in time is usually judged to cause less impact than impulsive noises. MATEP will have no associated pure-tones and the noise will be continuous in time. No impulsive sounds are anticipated. The dominant noise discernible in the area will be the sound of falling water in the cooling tower, a relatively unintrusive noise. The noise from mechanical equipment within the plant (e.g., diesel engines) which might be more impulsive will not be noticeable to the community.

(4) Previous Exposure

If there has been some previous exposure to a noise of a similar type as the new noise source, the impact is judged to be less than if the noise was of a new type. Portions of the community (including those in proximity to the site) have already adapted to noise levels from either

roof-top mechanical equipment or from the existing power plant which are similar to and higher than those expected from MATEP. The magnitude and type of noise from MATEP is not expected to be intrusive in relation to the existing nature of the community.

(5) Magnitude of the Noise

The initial factor in determining noise impact must be the relative magnitude of any expected noise increase. Sections 5.4.1, 5.4.2 and 5.4.3 have demonstrated that some critical receptors will see worst-case increases of 5-6 dB while others will see improvements in noise levels due to the retirement of the existing plant. Normally, even the critical receptors will see increases less than 5 dB. Stevens et al conclude that noise level increases of this magnitude will result in no perceived impact to the community. As they note "from previous experience, we believe that the range of variation usually encountered in the reactions of a community to a given noise is so wide that a change of noise level of less than 5 dB would not produce a significant change in the general pattern of reaction to the noise."

In the Stevens methodology, the community impact resulting from a noise level increase is either mitigated or aggravated by the factors discussed above. Case studies indicate that a dB increase of x which is mitigated by one of the above factors will result in community impact similar to x - 5 dB increase. For MATEP, where the increase begins at 5-6 dB and is mitigated by a combination of factors, the resulting impact is expected to be the same as if there were no increase in dB levels, i.e., no significant impact (see Figure 5-4).

5.5 Alternatives

5.5.1 Plant Capacity Reduction

The cooling towers have been discussed as the most significant noise source associated with operation of the MATEP facility. It has been demonstrated that 57-58 dB is the lowest noise level which can be attained without a reduction in plant capacity. To achieve a 50 dBA total plant design criterion level would require the cooling towers not to exceed 47-48 dB. It was determined that operation of a mechanical draft cooling tower at 1/2 speed would reduce the exhaust noise by about 5 dB, and have a negligible effect on the intake noise. It is estimated that a 10 dB reduction in the noise from the cooling tower would require operation of 1/2 of the cells at 1/2 fan speed. This requires a cooling load 1/4 of design requirements to meet the 47-48 dBA criterion. Cooling load decreases of this magnitude are not feasible.

If the electric generation were to be eliminated from the energy plant, the diesels could be eliminated. The noise levels would still remain about the same because even on peak summer days the diesels contribute less than 10% of the required cooling tower load. This reduction in cooling load would not appreciably change the noise levels of the cooling towers. If, on the other hand, steam and chilled water were to be eliminated from MATEP the cooling load would be reduced sufficiently to allow a 50 dBA criteria to be met. Steam and chilled water will still have to be supplied by a new facility(ies) somewhere in the immediate area thereby creating the equivalent (or higher) noise levels elsewhere. If this were done, the fuel saving advantages of cogeneration of steam and electricity would be lost, thus resulting in higher fuel consumption for the same utilities.

5.5.2 Institutional Energy Conservation

As discussed in Section 5.5.1 a reduction of 75% would have to be realized in cooling load to reduce cooling tower noise sufficiently to enable the MATEP facility to achieve a 50 dBA design criteria. Although energy conservation is being pursued on all levels of usage in the institutional community a reduction of 75% would be unrealistic. Even if limited savings could be made it would not eliminate the occurances of extreme weather conditions where total designed plant cooling load demands would have to be utilized.

5.5.3 Forego Construction of MATEP Facility

As discussed in Section 7 "Alternatives to the Proposed Project and Their Probable Impact on the Environment" of the previously accepted Final Environmental Impact Report the increasing demand for electricity, steam and chilled water requires the MATEP facility to become operational in the near future to ensure that the hospitals will be able to operate at their planned levels. The FEIR discusses in detail why construction of the MATEP facility is necessary and why the energy plant is more attractive than several other alternatives.

5.6 Mitigation Measures

The noise design program began with the determination of both the existing ambient sound levels in the environs and the major noise sources associated with operation of the proposed facility. The ambient sound levels are presented in Section 5.2. The following noise sources were determined as the major contributors to the noise levels to be realized by the community.

1) Cooling Towers
2) Heating, Ventilating, Air Conditioning (HVAC) Equipment
3) Precipitators
4) Stack
5) In-Plant Noise Levels Transmitted Through Building Enclosure
6) Boiler Steam Cleaning
7) Safety Relief Valves

Since item (6), Boiler Steam Cleaning, is a one time event before commercial operation of the plant and item (7), Safety Relief Valves, are a noise source associated with emergency conditions, they are considered separately and discussed in Section 5.3. Therefore, items (1) through (5) were evaluated to determine the resultant sound level radiated to the community. It became readily apparent that the noise level associated with the cooling towers would dominate and, therefore, dictate the resulting noise level from the facility. To achieve a specific criterion, it is required that each major noise source be silenced to a value below the criterion, such that the acoustic sum (energy basis) does not exceed the criterion. In budgeting the criterion among the major noise sources, UE&C specified a 1 dB design

allowance and assigned approximately one-half of the remaining noise budget to the cooling towers since they are subject to the most severe design restrictions.

The primary alternatives considered were as follows:

1) Satisfy all requirements of the Regulations.

2) Satisfy the single number equivalent of 50 dBA with no octave band restrictions.

3) Lowest achievable noise level.

Major cooling tower manufacturers were contacted for information on cooling towers and resultant noise levels. The following major criteria were specified for their consideration:

1) Required Cooling Performance - A guarantee that the towers cool 88,000 gallons of water per minute from $104^{O}F$ to $85^{O}F$ at a wet bulb temperature of $74^{O}F$ to satisfy the cooling demands of the facility.

2) Available Roof Area - An available roof area of 190' x 134' was defined by the plant site-building size limitations and the requirements of other necessary roof-top equipment, notably the electrostatic precipitators and associated ductwork.

3) Heating Coils for plume abatement must be provided.

4) Silencing - The maximum silencing attainable given the foregoing constraints. Silencing was requested to meet 47 dBA with octave band restrictions conforming to the Boston Noise Code (design goal of the Boston Regulations); 47 dBA with no octave band restrictions (design goal of 50 dBA); 55 dBA (design goal of approximately

57-58 dBA); and 57-58 dBA (design goal of 60 dBA) (both to ascertain lowest achievable level).

Although the criteria are conflicting in their effects on certain design parameters, only design options which did not cause an increase in resulting noise levels were allowed. For example, the cooling tower cells were made as small as possible (and still allow guaranteed cooling performance) to provide as much room as possible for silencing. This results in an increased tower height and greater air pressure drop. To overcome the pressure drop required by the fill and the acoustical silencing, the towers are required to use the largest, currently available and proven fans that can provide the necessary air flow at acceptable operating pressure conditions. In other words, the towers have been proportioned to utilize the maximum pressure drop available from the propeller type fans.

An increase in fan size only results in an increase in air flow quantity while the maximum pressure drop at any flow is limited by considerations of fan stability. The only alternative to increasing available pressure is to use a different type of fan which would increase the tower size, fan horsepower and noise level, thus requiring more silencing, thereby defeating the purpose of the alternative fans.

In parallel with the requests to the cooling tower vendors, UE&C investigated the noise from the silencing of cooling towers. Initially, one cooling tower vendor had stated that they could silence their tower to 50 dBA. Their proposal clearly stated and demonstrated that they could not meet the octave band requirements of the Boston Noise Code. Since UE&C could not satisfactorily resolve the acceptability of this proposal from the data supplied,

UE&C went to Germany to discuss the silencing with the manufacturer's German licensor and to physically measure noise levels associated with silenced cooling towers in Europe. It was established that the 50 dBA applied to selected receptors in the area only and did not apply at the facility boundaries. Subsequent data obtained from the tower vendor and its licensor established that neither the Boston Regulations, in octave bands, or a 50 dBA level could be obtained, and that a level in the approximate mid-50's dBA represented the lowest level obtainable with a proven cooling tower design utilizing proven components.

Another U.S. company made a preliminary proposal for a cooling tower silenced to about the 50 dBA level with extreme penalties in cost, horsepower, and physical size. The proposed tower could not be installed on the facility without interfering with the roof area required for the electrostatic precipitators or increasing the structure mass to unacceptable proportions.

UE&C conducted field evaluations on a similar sized cooling tower and designed a silencing system with the objective of achieving the lowest possible noise level within the specified constraints. The lowest level that could be achieved within the various design constraints with adequate engineering certainty was approximately 56 dBA.

The information available from all sources indicated that the best boundary line silenced sound level that could be achieved for the cooling towers associated with the MATEP facility is approximately 55-56 dBA. This level combined with a 2 dBA design factor to assure conservatism, is the basis for the cooling tower specifications and establishes the noise budget for the balance of the facility. This resulted in the 57-58 dBA cooling tower noise

boundary criterion used to calculate community impacts. The balance of the plant was then stringently silenced such that the total noise level from the plant would be less than 60 dBA at the noise boundary. (To appreciate the significance of this, it is necessary to realize that the acoustic sum of all other noise sources will be less than 51 dBA resulting in a combined level with the cooling towers of less than 60 dBA.)

In addition to the induced draft cooling towers proposed, UE&C also investigated an alternative using many small forced draft cooling units at more than double the horsepower. This type of tower configuration resulted in noise levels that could not be silenced to meet a 60 dBA community noise criteria, much less a 50 dBA community noise criterion.

The 60 dBA level represents the very lowest that can be reliably proposed using generally accepted engineering analysis and state-of-the-art technology. It is an achievable noise level for the total ultimate capacity. The analysis was performed on the basis of the ultimate plant expansion potential and associated loads, generally accepted design factors and current, proven technology. For example, the cooling tower analysis was performed using sound levels associated with eight cooling towers running at maximum capacity. In actual operation, this condition is expected to occur only for limited times during a worst case summer heat wave wherein both the wet bulb and dry bulb temperatures are above the normal levels associated with the Boston area. Under normal summer conditions only seven cooling tower cells will be in operation.

To summarize, there is no feasible alternative to the 60 dBA design criterion. Any action taken to further decrease noise levels from MATEP will unacceptably jeopardize plant performance, reliability, or capacity.

The following extreme design measures were undertaken to reduce noise levels to the lowest achievable.

1) The cooling towers will incorporate sound attenuators on both the air intakes and discharges. To the best of knowledge, this represents the only installation of this size and type using this concept.

2) All heating, ventilating and air conditioning intakes and exhausts will incorporate sound attenuators and/or other acoustical treatment.

3) Vibrators and rappers on the roof-top precipitators will be silenced.

4) Stack noise from the diesels will be silenced by the thermal after-burners-heat recovery steam generator system.

5) Walls and windows will be specially designed for significant noise attenuation. All windows will be sealed.

6) Temporary silencers will be installed to mitigate the effects of steam releases associated with boiler steam cleaning (a one-time event required before initial operation). To further mitigate the impact, steam releases will be scheduled only during weekdays from 8 AM to 4:30 PM and the surrounding neighborhood will be duly notified.

7) All boilers will be provided with power-operated relief valves which will incorporate silencers. These relief valves are set at

a lower trip release than the coded safety relief valves. With this relief system and the sophisticated combustion control system the emergency release of safety valves is highly unlikely.

8) A significant mitigation measure that will reduce noise levels will be the retirement of the existing power plant. The existing plant is significantly noisier than MATEP will be and portions of the area will experience a reduction in noise levels.

The requested deviation is of such a nature that no significant community impact is expected. However, if an unforeseen occurrence results in a situation where exposure to a receptor is deemed unacceptable, there are certain mitigation measures that could be pursued. These primarily consist of acoustical treatment of buildings and/or construction of off-site acoustic barriers.

REFERENCES

1. American National Standards Institute, 1969, "Draft Method for Measurement of Community Noise," ANSI S3-W-50.

2. U.S. Department of Housing and Urban Development Circular #1390.2, 1971, "Noise Abatement and Control: Departmental Policy, Implementation Responsibilities and Standards."

3. Wesler, J. E., 1972, Manual for Highway Noise Prediction.

4. U.S. Environmental Protection Agency, 1974, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," #550/9-74-004.

5. American National Standards Institute, 1973, "Specifications for Precision Sound Level Meters," ANSI S1.4-1973.

6. International Organization for Standardization, (1961), "Recommendations for Sound Level Meters," IEC-123.

7. International Organization for Standardization, 1971, "Specifications for Precision Sound Level Meters," IEC-179.

8. Stevens, Rosenblith, Bolt, 1955, "A Community's Reaction to Noise: Can It Be Forecast?" Noise Control, Vol. 1, No. 1, 63-71.

TABLE 5-1

REPRESENTATIVE ENVIRONMENTAL SOUND LEVELS

Source	Sound Levels (dBA)	Type	Effect
Jet plane takeoff	150	Deafening	Short exposure can cause hearing loss
Jet plane takeoff	140		Threshold of pain
Artillery fire, machine gun, riveting	130		
Siren at 100 ft, jet, accelerating motorcycle, hard rock band	120		Threshold of discomfort
Woodworking shop, accelerating motorcycle, hard rock band	110		
Subway (steel wheels), loud street noise, power lawnmower, outboard motor	100	Very loud	
Truck unmuffled, train whistle, kitchen blender, pneumatic jack hammer	90		OSHA regulation level for 8 hr exposure
Printing press, subway (rubber wheels), noisy office, average factory	80	Loud	Intolerable for phone use
Average street noise, quiet typewriter, freight train at 100 ft, average radio	70		
Noisy home, average office, normal conversation	60	Moderate	
General office, quiet radio, average home, quiet street	50		
Private office, quiet home	40	Faint	
Quiet conversation, broadcast studio	30		
Empty auditorium, whisper	20	Very faint	
Rustling leaves, soundproof room, breathing	10		
	0		Threshold of audibility

TABLE 5-2

AMBIENT NOISE SURVEY
SUMMARY OF RESIDUAL (L90) SOUND LEVELS
(dBA re 20 μ Pa)

DATE	DESCRIPTION	MEASUREMENT LOCATIONS* 1	2	3	4	5	6	7	8	9	10	11	12	13
7-17-76	SATURDAY-DAY	61.0	64.0	60.0	72.0	80.0	53.0	54.0	51.0	55.0	54.0	-	-	-
7-18-76	SUNDAY-NIGHT	53.0	56.0	59.0	72.0	80.0	54.0	52.0	42.0	54.0	51.0	-	-	-
7-18-76	SUNDAY-DAY	55.0	59.0	61.0	71.0	80.0	56.0	54.0	50.0	57.0	54.0	-	-	-
7-18-76	SUNDAY-EVENING	57.0	60.0	60.0	72.0	79.5	54.0	55.0	54.0	59.0	56.0	-	-	-
7-19-76	MONDAY-DAY	54.0	62.0	63.0	71.0	80.0	56.0	54.0	53.0	58.0	58.0	-	-	-
7-19-76	MONDAY-EVENING	56.0	62.0	60.0	72.0	80.0	54.0	52.0	52.0	56.0	54.0	-	-	-
7-20-76	TUESDAY-NIGHT	51.5	58.0	59.0	72.5	80.0	54.0	52.0	45.0	54.0	51.0	-	-	-
7-20-76	TUESDAY-DAY	58.0	65.0	61.0	72.0	80.0	57.0	57.0	63.0	61.0	58.0	-	-	-
7-22-76	THURSDAY-EVENING	54.0	64.0	59.0	73.0	80.0	55.0	56.0	49.5	56.0	57.0	-	-	-
7-22-76	THURSDAY-NIGHT	53.5	63.0	61.0	73.0	80.0	55.0	55.0	51.0	59.0	54.5	-	-	-
8-17-76	TUESDAY-NIGHT	53.0	55.0	58.0	73.5	80.0	57.5	53.5	44.0	57.0	53.0	61.0	60.0	59.0
3-18-77	THURSDAY-NIGHT (TOWERS OFF)	52.0	56.0	65.0	61.0	58.0	54.0	51.5	46.0	54.0	53.5	-	-	58.0
3-18-77	THURSDAY-NIGHT (TOWERS ON)	52.0	55.0	66.0	64.0	71.0	54.0	51.5	44.5	55.0	53.0	-	-	58.5

*SEE FIGURE 5-2

NOTE: DETAILED TABULATION OF AMBIENT NOISE SURVEY IS PRESENTED IN TABLES 5-3 THROUGH 5-16.

TABLE 5-3 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 1*
SOUND PRESSURE LEVEL IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1316	SATURDAY-DAY	LMAX	79.0	68.0	80.0	69.0	79.0	54.0	68.0	60.0	60.0	60.0	35.0	D, F, H
			L50	64.0	65.0	69.0	62.0	66.0	51.0	50.0	48.0	37.0	34.0	22.0	D, F, H
			L90	61.0	64.0	67.0	61.0	65.0	50.0	49.0	45.0	37.0	25.0	20.0	D, F, H
			LMIN	60.0	64.0	66.0	60.0	64.0	49.0	48.0	45.0	36.0	25.0	19.0	D, F, H
7-18-76	0335	SUNDAY-NIGHT	LMAX	54.0	64.0	60.0	58.0	52.0	63.0	52.0	45.0	37.0	26.0	14.0	E, F, H
			L50	53.0	62.0	59.0	56.0	51.0	50.0	50.0	44.0	36.0	23.0	14.0	E, F, H
			L90	53.0	60.0	58.0	55.0	50.0	49.0	49.0	44.0	36.0	22.0	14.0	E, F, H
			LMIN	53.0	59.0	58.0	55.0	50.0	48.0	48.0	44.0	35.0	22.0	14.0	E, F, H
7-18-76	1305	SUNDAY-DAY	LMAX	67.0	67.0	74.0	74.0	56.0	60.0	65.0	50.0	56.0	53.0	20.0	D, F
			L50	56.0	66.0	65.0	65.0	55.0	53.0	49.0	45.0	35.0	27.0	19.0	D, F
			L90	55.0	64.0	64.0	63.0	54.0	52.0	48.0	44.0	34.0	24.0	19.0	D, F
			LMIN	54.0	63.0	63.0	61.0	53.0	51.0	48.0	43.0	34.0	23.0	19.0	D, F
7-18-76	1845	SUNDAY-EVENING	LMAX	72.0	70.0	68.0	68.0	62.0	79.0	61.0	64.0	41.0	29.0	16.0	D, F, H, J
			L50	58.0	64.0	64.0	60.0	55.0	55.0	51.0	46.0	38.0	23.5	15.0	D, F, H, J
			L90	57.0	63.0	64.0	59.0	54.0	53.0	49.0	44.0	37.0	23.5	15.0	D, F, H, J
			LMIN	55.0	62.0	63.0	57.0	53.0	51.0	47.0	44.0	37.0	23.5	15.0	D, F, H, J
7-19-76	1455	MONDAY-DAY	LMAX	63.0	75.0	81.0	66.0	62.0	72.0	66.0	62.0	56.0	51.0	16.0	D, F, G
			L50	56.0	70.0	67.0	62.0	60.0	56.0	56.0	52.0	48.0	38.0	15.0	D, F, G
			L90	54.0	68.0	65.0	61.0	58.0	54.0	54.0	51.0	46.0	36.0	15.0	D, F, G
			LMIN	53.0	65.0	64.0	59.0	57.0	53.0	52.0	51.0	45.0	35.0	15.0	D, F, G
7-19-76	1850	MONDAY-EVENING	LMAX	76.0	71.0	74.0	73.0	68.0	68.0	68.0	60.0	56.0	51.0	36.0	D, F, H
			L50	58.0	66.0	65.0	62.0	61.0	58.0	52.0	48.0	45.0	28.0	16.0	D, F, H
			L90	56.0	64.0	63.0	60.0	58.0	56.0	50.0	46.0	42.0	26.0	15.0	D, F, H
			LMIN	55.0	61.0	61.0	58.0	56.0	54.0	48.0	43.0	39.0	24.0	14.0	D, F, H

TABLE 5-3 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 1*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										NOISE
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	SOURCES**
7-20-76	0237	TUESDAY-NIGHT	LMAX	70.0	71.0	61.0	67.0	52.0	48.5	53.0	46.0	36.0	22.5	14.5	B,E,F,I,L
			L50	51.5	62.0	60.0	66.0	51.0	48.0	47.0	44.5	36.0	22.5	14.5	B,E,F,I,L
			L90	51.5	61.0	59.0	65.0	51.0	48.0	47.0	44.0	36.0	22.5	14.5	B,E,F,I,L
			LMIN	51.5	60.0	59.0	65.0	51.0	48.0	47.0	44.0	36.0	22.5	14.5	B,E,F,I,L
7-20-76	1001	TUESDAY-DAY	LMAX	65.0	76.0	73.0	84.0	77.0	71.0	54.0	59.0	58.0	54.0	41.0	D,F,H,M
			L50	60.0	67.0	65.0	70.0	57.0	60.0	52.0	50.0	40.0	26.0	17.0	D,F,H,M
			L90	58.0	64.0	63.0	67.0	54.0	58.0	50.0	48.0	38.0	24.0	15.0	D,F,H,M
			LMIN	57.0	62.0	60.0	65.0	52.0	57.0	49.0	47.0	37.0	24.0	15.0	D,F,H,M
7-22-76	1902	THURSDAY-EVENING	LMAX	79.0	71.0	79.0	69.0	73.0	73.0	69.0	67.0	63.0	62.0	62.0	B,D,F,H,M
			L50	56.0	66.0	65.0	59.0	54.5	53.0	54.0	49.0	46.0	25.5	17.0	B,D,F,H,M
			L90	54.0	61.0	64.0	58.5	53.5	51.0	51.0	48.0	40.0	24.0	16.0	B,D,F,H,M
			LMIN	53.0	60.0	63.0	58.0	53.0	50.0	51.0	48.0	40.0	23.0	15.0	B,D,F,H,M
7-22-76	2204	THURSDAY-NIGHT	LMAX	67.0	71.0	78.0	74.0	71.0	57.0	59.0	59.0	52.0	28.0	23.0	B,E,F,M
			L50	54.5	65.0	68.0	63.0	61.0	53.0	50.0	48.0	39.0	22.5	18.5	B,E,F,M
			L90	53.5	64.0	63.0	61.0	53.0	50.0	49.0	46.0	39.0	21.5	18.5	B,E,F,M
			LMIN	53.0	62.0	61.0	57.0	52.0	50.0	48.0	46.0	38.0	21.5	18.5	B,E,F,M
8-17-76	0200	TUESDAY-NIGHT	LMAX	58.0	64.0	65.0	82.0	52.0	50.0	55.0	47.0	39.0	26.0	19.0	E, F, I
			L50	53.0	63.0	63.0	59.0	52.0	49.5	48.0	46.5	39.0	23.0	19.0	E, F, I
			L90	53.0	62.0	62.0	59.0	52.0	49.5	47.0	46.0	38.5	22.0	19.0	E, F, I
			LMIN	53.0	61.0	61.0	58.0	51.0	49.0	47.0	46.0	38.0	22.0	19.0	E, F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-4 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 2*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1235	SATURDAY-DAY	LMAX	78.0	79.0	80.0	73.0	74.0	66.0	68.0	68.0	63.0	56.0	41.0	C, H
			L50	69.0	75.0	74.0	66.0	60.0	56.0	62.0	58.0	58.0	48.0	35.0	C, H
			L90	64.0	71.0	69.0	64.0	63.0	55.0	55.0	56.0	46.0	44.0	33.0	C, H
			LMIN	60.0	67.0	65.0	62.0	60.0	53.0	53.0	50.0	44.0	40.0	31.0	C, H
7-18-76	0345	SUNDAY-NIGHT	LMAX	79.0	68.0	70.0	67.0	67.0	66.0	52.0	58.0	58.0	37.0	14.0	D
			L50	58.0	64.0	63.0	63.0	61.0	56.0	51.0	49.0	40.0	28.0	14.0	D
			L90	56.0	63.0	62.0	60.0	58.0	54.0	50.0	46.0	39.0	27.0	14.0	D
			LMIN	55.0	62.0	61.0	58.0	56.0	53.0	49.0	45.0	38.0	26.0	14.0	D
7-18-76	1207	SUNDAY-DAY	LMAX	70.0	76.0	78.0	75.0	66.0	74.0	66.0	62.0	62.0	61.0	43.0	C, H
			L50	62.0	70.0	70.0	68.0	60.0	62.0	60.0	55.0	50.0	50.0	32.0	C, H
			L90	59.0	68.0	68.0	66.0	58.0	60.0	56.0	52.0	46.0	38.0	22.0	C, H
			LMIN	57.0	67.0	67.0	65.0	56.0	59.0	55.0	51.0	41.0	34.0	18.0	C, H
7-18-76	1805	SUNDAY-EVENING	LMAX	66.0	76.0	77.0	82.0	75.0	67.0	64.0	68.0	60.0	49.0	35.0	C, H
			L50	63.0	69.0	70.0	70.0	67.0	60.0	55.0	58.0	50.0	40.0	30.0	C, H
			L90	60.0	67.0	67.0	69.0	65.0	58.0	52.0	55.0	44.0	32.0	25.0	C, H
			LMIN	60.0	66.0	66.0	68.0	64.0	57.0	51.0	54.0	42.0	30.0	24.0	C, H
7-19-76	1440	MONDAY-DAY	LMAX	80.0	81.0	81.0	73.0	72.0	66.0	63.0	60.0	61.0	47.0	49.0	C, H, J
			L50	65.0	78.0	76.0	71.0	64.0	59.0	59.0	57.0	51.0	43.0	36.0	C, H, J
			L90	62.0	76.0	73.0	69.0	61.0	57.0	58.0	55.0	49.0	42.0	30.0	C, H, J
			LMIN	62.0	75.0	71.0	69.0	60.0	56.0	58.0	53.0	48.0	42.0	29.0	C, H, J
7-19-76	1806	MONDAY-EVENING	LMAX	70.0	75.0	76.0	77.0	76.0	77.0	68.0	61.0	56.0	54.0	54.0	C, H, J
			L50	64.0	70.0	70.0	74.0	70.0	64.0	62.0	55.0	50.0	42.0	30.0	C, H, J
			L90	62.0	69.0	67.0	72.0	66.0	67.0	58.0	52.0	46.0	36.0	21.0	C, H, J
			LMIN	62.0	67.0	66.0	71.0	64.0	60.0	57.0	52.0	45.0	36.0	20.0	C, H, J

TABLE 5-4 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 2*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-20-76	0245	TUESDAY-NIGHT	LMAX	72.0	75.0	68.0	69.0	57.0	66.0	51.0	49.0	62.0	28.0	18.0	D, I
			L50	59.0	66.0	63.0	63.0	56.0	55.0	50.0	47.0	41.0	27.0	17.0	D, I
			L90	58.0	64.0	61.0	62.0	56.0	54.0	50.0	47.0	41.0	27.0	16.0	D, I
			LMIN	58.0	63.0	61.0	61.0	56.0	54.0	50.0	47.0	41.0	27.0	16.0	D, I
7-20-76	0925	TUESDAY-DAY	LMAX	76.0	80.0	82.0	76.0	73.0	66.0	62.0	68.0	70.0	58.0	52.0	C
			L50	67.0	70.0	71.0	68.0	66.0	60.0	56.0	58.0	54.0	39.0	24.0	C
			L90	65.0	68.0	68.0	66.0	64.0	58.0	53.0	54.0	50.0	34.0	22.0	C
			LMIN	64.0	67.0	64.0	63.0	62.0	57.0	52.0	51.0	46.0	32.0	20.0	C
7-22-76	1803	THURSDAY-EVENING	LMAX	75.0	82.0	81.0	85.0	72.0	82.0	72.0	67.0	77.0	62.0	47.0	C, H, J
			L50	66.0	71.0	73.0	70.0	63.0	63.0	60.0	60.0	53.0	42.0	33.0	C, H, J
			L90	64.0	68.0	68.5	64.0	60.5	58.0	57.0	56.0	46.0	36.0	22.0	C, H, J
			LMIN	60.5	63.0	64.0	63.0	58.0	56.0	56.0	54.0	45.0	35.0	21.0	C, H, J
7-22-76	2215	THURSDAY-NIGHT	LMAX	79.0	74.0	73.0	90.0	74.0	77.0	74.0	70.0	70.0	50.0	50.0	C, H, I, J
			L50	73.0	68.5	67.0	71.5	68.0	65.0	64.0	54.0	51.0	40.0	34.0	C, H, I, J
			L90	63.0	64.0	64.0	63.0	60.0	57.0	60.0	48.0	46.0	37.0	20.0	C, H, I, J
			LMIN	62.0	63.0	63.0	61.0	57.0	57.0	59.0	47.0	45.0	36.0	20.0	C, H, I, J
8-17-76	0207	TUESDAY-NIGHT	LMAX	82.0	80.0	62.0	64.0	72.0	72.0	92.0	46.0	61.0	60.0	60.0	C, F, I
			L50	61.0	64.0	61.0	59.5	57.0	54.0	58.0	46.0	44.0	34.0	24.0	C, F, I
			L90	55.0	62.0	60.5	59.5	57.0	53.0	52.0	46.0	41.0	25.0	17.0	C, F, I
			LMIN	55.0	60.0	60.0	59.0	56.0	52.0	50.0	46.0	40.0	25.0	16.0	C, F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-5 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 3*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1245	SATURDAY-DAY	LMAX	67.0	72.0	74.0	72.0	69.0	61.0	64.0	56.0	49.0	49.0	22.0	B, E, F, H
			L50	61.0	70.0	67.0	66.0	61.0	59.0	55.0	52.0	44.0	33.0	20.0	B, E, F, H
			L90	60.0	69.0	66.0	64.0	61.0	58.0	54.0	51.0	43.0	32.0	19.0	B, E, F, H
			LMIN	59.0	68.0	65.0	63.0	60.0	56.0	53.0	50.0	43.0	32.0	18.0	B, E, F, H
7-18-76	0355	SUNDAY-NIGHT	LMAX	64.0	71.0	68.0	64.0	60.0	56.0	54.0	52.0	46.0	34.0	20.0	B, F
			L50	60.0	68.0	67.0	63.0	59.0	54.0	54.0	51.0	45.0	34.0	19.0	B, F
			L90	59.0	67.0	66.0	62.0	58.0	54.0	54.0	51.0	44.0	34.0	18.0	B, F
			LMIN	58.0	66.0	65.0	61.0	58.0	54.0	54.0	51.0	44.0	34.0	18.0	B, F
7-18-76	1225	SUNDAY-DAY	LMAX	66.0	71.0	79.0	79.0	69.0	70.0	64.0	55.0	54.0	37.0	19.0	B, E, F, H
			L50	63.0	69.0	73.0	71.0	64.0	64.0	57.0	53.0	46.0	34.0	18.0	B, E, F, H
			L90	61.0	68.0	70.0	68.0	62.0	61.0	55.0	52.0	44.0	33.0	18.0	B, E, F, H
			LMIN	60.0	67.0	67.0	67.0	60.0	60.0	54.0	51.0	44.0	33.0	17.0	B, E, F, H
7-18-76	1816	SUNDAY-EVENING	LMAX	64.0	72.0	68.0	69.0	64.0	64.0	63.0	54.0	48.0	38.0	18.0	B, E, F, H
			L50	61.0	69.0	67.0	65.0	60.0	59.0	55.0	51.0	44.0	35.0	17.0	B, E, F, H
			L90	60.0	68.0	66.0	63.0	59.0	58.0	54.0	51.0	43.0	32.0	16.0	B, E, F, H
			LMIN	59.0	67.0	65.0	62.0	59.0	57.0	54.0	50.0	43.0	32.0	16.0	B, E, F, H
7-19-76	1430	MONDAY-DAY	LMAX	65.0	77.0	73.0	71.0	68.0	63.0	63.0	63.0	57.0	47.0	40.0	B,E,F,H,I,J
			L50	64.0	72.0	70.0	67.0	66.0	60.0	60.0	57.0	52.0	41.0	23.0	B,E,F,H,I,J
			L90	63.0	71.0	69.0	65.0	65.0	59.0	59.0	56.0	51.0	39.0	22.0	B,E,F,H,I,J
			LMIN	63.0	70.0	68.0	64.0	65.0	59.0	58.0	55.0	51.0	39.0	22.0	B,E,F,H,I,J
7-19-76	1820	MONDAY-EVENING	LMAX	63.0	75.0	77.0	72.0	65.0	60.0	63.0	61.0	48.0	43.0	29.0	B, E, F, H
			L50	61.0	72.0	71.0	67.0	62.0	56.0	56.0	54.0	46.0	36.0	21.0	B, E, F, H
			L90	60.0	71.0	70.0	65.0	60.0	55.0	55.0	52.0	45.0	34.0	18.0	B, E, F, H
			LMIN	60.0	70.0	69.0	65.0	60.0	55.0	54.0	51.0	45.0	34.0	17.0	B, E, F, H

TABLE 5-5 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 3*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-20-76	0252	TUESDAY-NIGHT	LMAX	59.0	70.0	69.0	65.0	61.0	57.0	54.0	54.0	45.0	35.0	20.0	B, F, I
			L50	59.0	69.0	68.0	64.0	60.0	56.5	54.0	53.0	45.0	35.0	20.0	B, F, I
			L90	59.0	68.0	67.0	64.0	60.0	56.5	54.0	52.0	45.0	35.0	20.0	B, F, I
			LMIN	59.0	68.0	66.0	64.0	60.0	56.5	54.0	52.0	45.0	35.0	20.0	B, F, I
7-20-76	0935	TUESDAY-DAY	LMAX	65.0	76.0	80.0	71.0	62.0	63.0	58.0	67.0	53.0	41.0	26.0	B, E, F, H
			L50	61.5	68.0	71.0	66.0	60.0	58.0	55.0	52.0	46.0	37.5	22.0	B, E, F, H
			L90	61.0	67.0	68.0	65.0	59.0	57.0	54.0	51.0	45.0	36.5	21.0	B, E, F, H
			LMIN	60.0	65.0	66.0	63.0	58.0	55.0	54.0	51.0	45.0	36.5	21.0	B, E, F, H
7-22-76	1817	THURSDAY-EVENING	LMAX	64.0	83.0	78.0	90.0	68.0	59.0	59.0	68.0	65.0	39.0	30.0	B,D,F,H,J
			L50	60.5	69.0	71.0	65.5	62.0	56.0	55.5	53.0	47.0	33.0	19.0	B,D,F,H,J
			L90	59.0	67.0	66.0	64.5	60.5	55.0	53.5	53.0	46.0	32.0	18.0	B,D,F,H,J
			LMIN	59.0	64.0	64.0	64.0	59.0	54.5	53.0	52.0	45.0	31.0	17.5	B,D,F,H,J
7-22-76	2228	THURSDAY-NIGHT	LMAX	65.0	74.0	71.0	72.0	68.0	62.0	58.0	58.0	59.0	52.0	49.0	B, E, F
			L50	62.0	67.0	69.0	64.0	60.0	55.0	54.0	51.0	53.0	36.0	19.0	B, E, F
			L90	61.0	65.0	66.0	62.0	58.5	55.0	53.0	51.0	47.0	32.5	18.0	B, E, F
			LMIN	60.0	62.0	62.0	62.0	57.0	54.0	52.0	51.0	46.0	32.5	18.0	B, E, F
8-17-76	0225	TUESDAY-NIGHT	LMAX	58.0	60.0	67.0	65.0	62.0	61.0	54.0	52.0	44.0	32.5	18.0	B, E, F
			L50	58.0	59.0	66.0	64.0	60.5	55.0	53.5	52.0	44.0	32.5	18.0	B, E, F
			L90	58.0	59.0	66.0	63.0	60.5	55.0	53.5	52.0	44.0	32.5	18.0	B, E, F
			LMIN	58.0	58.0	65.0	63.0	60.5	54.0	53.5	52.0	44.0	32.5	18.0	B, E, F

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-6 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 4*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1255	SATURDAY-DAY	LMAX	75.0	78.0	77.0	77.0	71.0	67.0	68.0	67.0	63.0	60.0	48.0	A, E
			L50	73.0	75.0	74.0	72.0	67.0	65.0	67.0	67.0	62.0	58.0	47.0	A, E
			L90	72.0	74.0	73.0	71.0	66.0	64.0	67.0	67.0	62.0	57.0	46.0	A, E
			LMIN	72.0	73.0	73.0	70.0	66.0	64.0	67.0	66.0	62.0	57.0	46.0	A, E
7-18-76	0400	SUNDAY-NIGHT	LMAX	72.0	76.0	74.0	68.0	65.0	63.0	68.0	67.0	62.0	56.0	42.0	A
			L50	72.0	75.0	73.0	67.0	64.0	63.0	67.0	67.0	62.0	56.0	42.0	A
			L90	72.0	74.0	72.0	67.0	64.0	63.0	67.0	67.0	62.0	56.0	42.0	A
			LMIN	72.0	73.0	71.0	67.0	64.0	63.0	67.0	67.0	62.0	56.0	42.0	A
7-18-76	1244	SUNDAY-DAY	LMAX	74.0	77.0	84.0	71.0	73.0	70.0	70.0	65.0	60.0	54.0	34.0	A, E, H
			L50	72.0	75.0	75.0	69.0	70.0	66.0	66.0	64.0	59.0	51.0	32.0	A, E, H
			L90	71.0	74.0	73.0	68.0	68.0	64.0	65.0	64.0	58.0	49.0	31.0	A, E, H
			LMIN	71.0	73.0	72.0	67.0	67.0	63.0	65.0	63.0	58.0	49.0	30.0	A, E, H
7-18-76	1824	SUNDAY-EVENING	LMAX	73.0	78.0	76.0	71.0	73.0	69.0	69.0	67.0	61.0	52.0	41.0	A, E, H
			L50	72.0	76.0	74.0	70.0	67.0	66.0	67.5	66.0	60.5	51.0	37.0	A, E, H
			L90	72.0	75.0	73.0	69.0	66.0	65.0	67.0	66.0	60.0	51.0	36.0	A, E, H
			LMIN	72.0	75.0	73.0	69.0	66.0	64.0	66.0	66.0	60.0	51.0	36.0	A, E, H
7-19-76	1406	MONDAY-DAY	LMAX	74.0	79.0	84.0	86.0	79.3	69.0	69.0	70.0	62.0	56.0	38.0	A, D, H
			L50	72.0	76.0	78.0	74.0	78.0	65.0	67.0	67.0	61.0	52.0	35.0	A, D, H
			L90	71.0	75.0	76.0	71.0	77.0	64.0	66.0	66.0	60.0	51.0	34.0	A, D, H
			LMIN	71.0	74.0	75.0	70.0	77.0	64.0	66.0	66.0	60.0	51.0	33.0	A, D, H
7-19-76	1827	MONDAY-EVENING	LMAX	74.0	78.0	84.0	71.0	68.0	72.0	68.0	67.0	61.0	57.0	42.0	A, E, H
			L50	73.0	76.0	75.0	70.0	67.0	66.0	67.5	66.5	61.0	54.0	41.0	A, E, H
			L90	72.0	75.0	73.0	70.0	66.0	65.0	67.0	66.5	61.0	53.0	40.0	A, E, H
			LMIN	72.0	75.0	72.0	69.0	66.0	65.0	67.0	66.5	61.0	53.0	40.0	A, E, H

TABLE 5-6 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 4*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-20-76	0256	TUESDAY-NIGHT	LMAX	72.5	76.0	75.0	71.0	68.0	65.5	67.5	67.0	63.0	56.5	44.5	A
			L50	72.5	75.0	74.0	70.0	67.0	65.5	67.5	67.0	63.0	56.5	44.5	A
			L90	72.5	74.0	73.0	69.0	67.0	65.5	67.5	67.0	63.0	56.5	44.5	A
			LMIN	72.5	74.0	73.0	69.0	67.0	65.5	67.5	67.0	63.0	56.5	44.5	A
7-20-76	0941	TUESDAY-DAY	LMAX	74.0	97.0	79.0	80.0	69.0	70.0	69.0	67.0	62.5	62.0	44.0	A, D
			L50	73.0	77.0	76.0	72.0	67.0	65.0	67.0	66.0	61.5	56.0	43.0	A, D
			L90	72.0	75.0	74.0	70.0	66.0	64.0	66.0	65.0	61.0	55.0	42.0	A, D
			LMIN	72.0	73.0	73.0	69.0	65.0	63.0	66.0	65.0	61.0	55.0	42.0	A, D
7-22-76	1833	THRUSDAY-EVENING	LMAX	74.0	78.0	82.0	75.0	69.0	72.0	70.0	71.0	66.0	58.0	44.0	A, D, H
			L50	73.5	74.0	74.0	69.5	65.0	65.0	68.5	68.0	63.5	56.5	43.0	A, D, H
			L90	73.0	72.5	71.5	67.5	64.0	64.0	68.0	67.5	63.5	56.5	43.0	A, D, H
			LMIN	73.0	70.0	69.0	66.5	63.0	63.0	68.0	67.0	62.0	56.0	42.0	A, D, H
7-22-76	2235	THURSDAY-NIGHT	LMAX	76.0	78.0	76.0	76.0	67.0	66.0	68.0	68.0	63.5	57.0	63.0	A, E
			L50	73.5	73.0	73.0	68.0	65.0	64.0	67.5	67.5	63.5	57.0	46.0	A, E
			L90	73.0	71.0	72.0	67.0	64.0	63.0	67.5	67.5	63.5	57.0	43.0	A, E
			LMIN	73.0	69.0	70.0	66.0	63.0	62.0	67.0	67.0	63.0	57.0	43.0	A, E
8-17-76	0231	TUESDAY-NIGHT	LMAX	73.5	77.0	75.0	70.0	68.0	66.0	68.5	68.0	64.0	57.0	45.5	A
			L50	73.5	75.5	74.0	69.0	67.0	66.0	68.5	68.0	64.0	57.0	45.5	A
			L90	73.5	75.0	73.5	69.0	67.0	66.0	68.5	68.0	64.0	57.0	45.5	A
			LMIN	73.5	74.0	73.0	69.0	66.0	66.0	68.5	68.0	64.0	56.5	45.5	A

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-7 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 5*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1300	SATURDAY-DAY	LMAX	80.0	80.0	77.0	79.0	77.0	74.0	75.0	74.0	71.0	67.5	59.0	A, E
			L50	80.0	78.0	75.0	77.0	76.0	73.0	74.0	73.0	71.0	67.5	59.0	A, E
			L90	80.0	77.0	74.0	75.0	76.0	73.0	74.0	73.0	71.0	67.5	59.0	A, E
			LMIN	80.0	77.0	73.0	74.0	76.0	73.0	74.0	73.0	71.0	67.5	59.0	A, E
7-18-76	0405	SUNDAY-NIGHT	LMAX	80.0	77.0	75.0	74.0	74.0	72.0	74.0	74.0	72.0	68.0	60.0	A
			L50	80.0	76.0	74.0	73.0	73.0	71.0	74.0	74.0	72.0	68.0	60.0	A
			L90	80.0	75.0	73.0	73.0	73.0	71.0	74.0	74.0	72.0	68.0	60.0	A
			LMIN	80.0	74.0	73.0	72.0	73.0	71.0	74.0	74.0	72.0	68.0	60.0	A
7-18-76	1239	SUNDAY-DAY	LMAX	80.0	79.0	75.0	77.0	75.0	73.0	80.0	74.0	71.0	67.5	59.5	A, E, H
			L50	80.0	75.0	73.0	76.0	74.0	72.0	75.0	74.0	71.0	67.5	59.5	A, E, H
			L90	80.0	74.0	72.0	75.0	73.0	72.0	74.0	74.0	71.0	67.5	59.5	A, E, H
			LMIN	79.0	74.0	72.0	74.0	73.0	72.0	74.0	73.0	71.0	67.5	59.5	A, E, H
7-18-76	1834	SUNDAY-EVENING	LMAX	79.5	78.0	76.0	77.0	76.0	73.0	74.5	73.5	71.0	67.5	58.5	A, E, H
			L50	79.5	75.0	75.0	76.0	75.0	72.5	74.5	73.5	71.0	67.5	58.5	A, E, H
			L90	79.5	74.0	74.0	75.0	75.0	72.0	74.5	73.5	71.0	67.5	58.5	A, E, H
			LMIN	79.5	75.0	75.0	76.0	75.0	72.5	74.5	73.5	71.0	67.5	58.5	A, E, H
7-19-76	1400	MONDAY-DAY	LMAX	82.0	79.0	82.0	79.0	85.0	74.0	75.0	73.5	73.0	67.0	58.0	A, D
			L50	81.0	77.0	78.0	78.0	77.0	73.0	75.0	73.5	71.0	66.5	57.5	A, D
			L90	80.0	76.0	76.0	77.0	76.0	73.0	75.0	73.5	70.5	66.5	57.0	A, D
			LMIN	80.0	76.0	75.0	77.0	75.0	73.0	74.0	73.5	70.5	66.5	57.0	A, D
7-19-76	1834	MONDAY-EVENING	LMAX	80.0	78.0	80.0	78.0	77.0	73.0	75.0	74.0	70.5	66.5	57.0	A, E
			L50	80.0	76.0	76.0	77.0	76.5	73.0	75.0	74.0	70.5	66.5	57.0	A, E
			L90	80.0	75.0	75.0	77.0	76.0	73.0	75.0	73.5	70.5	66.5	57.0	A, E
			LMIN	80.0	75.0	74.0	77.0	76.0	73.0	74.0	73.5	70.5	66.5	57.0	A, E

TABLE 5-7 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 5*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										NOISE
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	SOURCES**
7-20-76	0300	TUESDAY-NIGHT	LMAX	80.0	80.0	77.0	77.0	78.0	74.0	75.0	74.0	72.0	69.0	60.5	A
			L50	80.0	79.0	76.0	76.5	77.5	73.5	75.0	74.0	72.0	68.5	60.5	A
			L90	80.0	78.0	75.0	76.5	77.0	73.0	75.0	74.0	72.0	68.5	60.5	A
			LMIN	80.0	78.0	75.0	76.5	77.0	73.0	75.0	74.0	72.0	68.5	60.5	A
7-20-76	0949	TUESDAY-DAY	LMAX	80.0	81.0	79.0	77.0	78.0	73.5	75.0	74.0	71.5	68.5	60.5	A, E
			L50	80.0	79.0	77.0	76.5	77.0	73.0	74.5	74.0	71.5	68.5	60.5	A, E
			L90	80.0	78.0	76.0	76.5	76.0	73.0	74.5	74.0	71.5	68.5	60.5	A, E
			LMIN	80.0	78.0	76.0	76.5	76.0	73.0	74.5	74.0	71.5	68.5	60.5	A, E
7-22-76	1845	THURSDAY-EVENING	LMAX	81.0	80.0	85.0	88.0	76.0	73.0	76.0	75.0	81.0	66.0	59.5	A, D
			L50	80.0	75.0	75.5	73.0	74.0	71.5	74.5	74.0	71.5	66.0	59.5	A, D
			L90	80.0	74.0	73.0	72.0	73.0	70.0	74.5	74.0	71.0	66.0	59.5	A, D
			LMIN	80.0	70.0	70.0	70.0	72.0	70.0	74.0	74.0	71.0	66.0	59.5	A, D
7-22-76	2241	THURSDAY-NIGHT	LMAX	80.0	81.0	77.0	77.0	77.0	76.0	75.5	74.5	72.5	69.5	61.5	A, E
			L50	80.0	75.0	74.5	74.5	73.0	71.5	74.5	74.0	72.5	69.5	61.0	A, E
			L90	80.0	73.5	72.0	73.0	73.0	71.0	74.0	74.0	72.5	69.5	61.0	A, E
			LMIN	80.0	72.0	70.0	72.0	72.0	70.5	73.5	73.5	72.5	69.0	61.0	A, E
8-17-76	0235	TUESDAY-NIGHT	LMAX	80.0	78.0	77.0	74.0	75.0	71.0	74.0	74.0	72.0	68.0	59.5	A
			L50	80.0	78.0	75.0	73.5	74.0	71.0	74.0	74.0	72.0	68.0	59.5	A
			L90	80.0	78.0	75.0	73.5	74.0	71.0	74.0	74.0	72.0	68.0	59.5	A
			LMIN	80.0	77.0	74.0	73.0	73.5	71.0	74.0	74.0	72.0	68.0	59.5	A

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-8 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 6*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										NOISE
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	SOURCES**
7-17-76	1310	SATURDAY-DAY	LMAX	55.0	69.0	68.0	64.0	57.5	52.0	51.0	46.0	39.0	30.0	24.0	B, F, I
			L50	54.0	66.0	64.0	60.0	57.0	50.0	49.0	45.0	38.0	28.0	21.0	B, F, I
			L90	53.0	65.0	63.0	59.0	55.0	50.0	48.0	44.0	37.0	27.0	20.5	B, F, I
			LMIN	53.0	64.0	63.0	59.0	54.0	49.0	48.0	44.0	36.0	26.0	20.5	B, F, I
7-18-76	0410	SUNDAY-NIGHT	LMAX	54.0	69.0	64.0	59.0	54.0	51.0	50.0	47.0	41.0	27.0	15.0	B, I
			L50	54.0	67.0	63.0	58.0	53.0	50.0	49.0	46.0	40.0	27.0	14.0	B, I
			L90	54.0	66.0	62.0	57.0	53.0	49.0	49.0	46.0	39.0	27.0	14.0	B, I
			LMIN	54.0	65.0	61.0	57.0	52.0	49.0	48.0	46.0	39.0	26.0	14.0	B, I
7-18-76	1255	SUNDAY-DAY	LMAX	65.0	71.0	68.0	64.0	57.0	72.0	71.0	46.0	42.0	39.0	26.0	B,F,H,I,N
			L50	59.0	68.0	64.0	62.0	55.0	54.0	49.0	45.0	40.0	30.0	24.0	B,F,H,I,N
			L90	56.0	66.0	63.0	60.0	54.0	51.0	48.0	45.0	39.0	29.0	23.0	B,F,H,I,N
			LMIN	55.0	65.0	63.0	60.0	53.0	50.0	48.0	45.0	39.0	28.0	23.0	B,F,H,I,N
7-18-76	1839	SUNDAY-EVENING	LMAX	55.0	68.0	67.0	63.0	75.0	53.0	54.0	48.0	40.0	27.0	18.0	B,F,H,I,K
			L50	54.0	67.0	64.0	60.0	61.0	52.0	51.0	47.0	38.0	26.0	18.0	B,F,H,I,K
			L90	54.0	66.0	63.0	59.0	59.0	51.0	50.0	46.0	37.0	25.0	18.0	B,F,H,I,K
			LMIN	54.0	64.0	63.0	59.0	58.0	51.0	49.0	45.0	37.0	25.0	18.0	B,F,H,I,K
7-19-76	1417	MONDAY-DAY	LMAX	60.0	78.0	82.0	66.0	67.0	69.0	62.0	62.0	60.0	50.0	36.0	B, D, F, H
			L50	57.0	68.0	74.0	63.0	59.0	57.0	57.0	51.0	50.0	35.0	25.0	B, D, F, H
			L90	56.0	67.0	70.0	62.0	57.0	55.0	52.0	49.0	45.0	31.0	20.0	B, D, F, H
			LMIN	56.0	67.0	69.0	61.0	56.0	54.0	51.0	49.0	44.0	30.0	18.0	B, D, F, H
7-19-76	1839	MONDAY-EVENING	LMAX	75.0	69.0	72.0	84.0	67.0	71.0	71.0	61.0	55.0	58.0	38.0	B,E,F,H,I,K
			L50	56.0	67.0	65.0	70.0	60.0	60.0	58.0	46.0	38.0	24.0	19.0	B,E,F,H,I,K
			L90	54.0	66.0	64.0	68.0	56.0	55.0	51.0	45.0	36.0	22.0	18.0	B,E,F,H,I,K
			LMIN	54.0	66.0	63.0	68.0	56.0	54.0	50.0	44.0	35.0	21.0	17.0	B,E,F,H,I,K

TABLE 5-8 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 6*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-20-76	0304	TUESDAY-NIGHT	LMAX	55.0	68.0	65.0	60.0	58.0	51.0	51.0	48.0	41.0	29.0	17.0	B,F,H,I,L
			L50	54.5	67.0	63.0	58.5	54.0	51.0	49.0	47.5	40.0	28.5	16.0	B,F,H,I,L
			L90	54.0	66.0	62.0	58.0	54.0	51.0	48.0	47.0	40.0	28.0	16.0	B,F,H,I,L
			LMIN	54.0	64.0	61.0	58.0	54.0	50.0	48.0	47.0	40.0	28.0	16.0	B,F,H,I,L
7-20-76	0955	TUESDAY-DAY	LMAX	60.0	80.0	74.0	71.0	58.0	68.0	63.0	62.0	60.0	46.0	41.0	D, F, H, I
			L50	58.0	66.0	66.0	63.0	56.0	55.0	53.0	47.5	42.0	33.0	22.0	D, F, H, I
			L90	57.0	64.0	63.0	61.0	55.0	53.0	52.0	46.5	41.0	32.0	21.0	D, F, H, I
			LMIN	57.0	62.0	61.0	60.0	54.0	52.0	51.0	46.5	41.0	32.0	20.0	D, F, H, I
7-22-76	1851	THURSDAY-EVENING	LMAX	72.0	71.0	69.0	61.0	56.0	64.0	74.0	49.0	71.0	54.0	43.0	B,E,F,I,J,M
			L50	55.5	65.0	64.0	58.5	54.0	51.5	52.0	47.0	39.5	39.5	19.5	B,E,F,I,J,M
			L90	55.0	63.0	63.0	58.0	53.0	51.0	50.0	46.5	39.0	39.0	19.0	B,E,F,I,J,M
			LMIN	55.0	60.0	61.0	57.0	52.0	50.0	50.0	46.0	39.0	38.0	19.0	B,E,F,I,J,M
7-22-76	2247	THURSDAY-NIGHT	LMAX	63.0	71.0	68.0	72.0	90.0	74.0	51.0	54.0	44.0	54.0	49.0	B,E,F,H,M
			L50	56.0	65.0	64.0	61.0	55.0	51.5	49.5	51.0	39.5	30.0	27.0	B,E,F,H,M
			L90	55.0	63.0	62.0	60.0	54.5	51.0	48.5	47.0	39.0	29.0	27.0	B,E,F,H,M
			LMIN	55.0	63.0	61.0	58.0	54.0	50.0	48.0	47.0	39.0	28.0	26.5	B,E,F,H,M
8-17-76	0145	TUESDAY-NIGHT	LMAX	58.0	77.0	92.0	60.0	59.0	54.0	52.0	72.0	41.0	29.0	17.0	B,E,F,H,L
			L50	57.5	69.0	66.0	60.0	58.5	54.0	50.0	50.0	41.0	29.0	17.0	B,E,F,H,L
			L90	57.5	68.0	65.0	60.0	58.5	54.0	50.0	50.0	41.0	29.0	17.0	B,E,F,H,L
			LMIN	57.5	68.0	63.0	60.0	58.0	54.0	50.0	50.0	41.0	29.0	17.0	B,E,F,H,L

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-9 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 7*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1330	SATURDAY-DAY	LMAX	72.0	74.0	73.0	71.0	64.0	67.0	66.0	49.0	57.0	54.0	36.0	D, F, J
			L50	56.0	61.0	66.0	63.0	58.0	53.0	50.0	47.0	41.0	30.0	29.0	D, F, J
			L90	54.0	61.0	64.0	61.0	56.0	52.0	49.0	44.0	37.0	27.0	22.0	D, F, J
			LMIN	54.0	61.0	62.0	60.0	55.0	51.0	48.0	43.0	36.0	26.0	21.0	D, F, J
7-18-76	0417	SUNDAY-NIGHT	LMAX	53.0	62.0	62.0	58.0	53.0	50.0	49.0	45.0	38.0	25.0	14.0	B, E
			L50	52.0	60.0	61.0	57.0	51.0	49.0	47.0	44.0	37.0	24.0	14.0	B, E
			L90	52.0	59.0	59.0	56.0	50.0	49.0	47.0	43.0	36.0	24.0	14.0	B, E
			LMIN	52.0	58.0	59.0	56.0	50.0	49.0	46.0	43.0	35.0	23.0	14.0	B, E
7-18-76	1315	SUNDAY-DAY	LMAX	68.0	64.0	63.0	62.0	64.0	66.0	64.0	60.0	40.0	43.0	56.0	D, H, N
			L50	55.0	60.0	62.0	57.0	56.0	53.0	49.0	45.0	39.0	36.0	23.0	D, H, N
			L90	54.0	59.0	62.0	56.0	54.0	51.0	48.0	44.0	38.0	32.0	22.0	D, H, N
			LMIN	53.0	58.0	62.0	55.0	52.0	49.0	47.0	43.0	36.0	31.0	20.0	D, H, N
7-18-76	1855	SUNDAY-EVENING	LMAX	72.0	74.0	70.0	68.0	71.0	68.0	62.0	48.0	59.0	52.0	42.0	D, H
			L50	57.0	67.0	68.0	63.0	56.0	53.0	49.0	45.0	38.0	28.0	22.0	D, H
			L90	55.0	65.0	66.0	62.0	54.0	52.0	47.0	44.0	37.0	27.0	21.0	D, H
			LMIN	54.0	62.0	64.0	60.0	54.0	50.0	46.0	43.0	37.0	26.0	21.0	D, H
7-19-76	1510	MONDAY-DAY	LMAX	68.0	71.0	73.0	73.0	73.0	64.0	63.0	60.0	58.0	52.0	19.0	D, H
			L50	55.0	66.0	64.0	63.0	56.0	53.0	51.0	52.0	46.0	35.0	17.0	D, H
			L90	54.0	64.0	63.0	61.0	55.0	51.0	49.0	51.0	44.0	33.0	16.0	D, H
			LMIN	54.0	63.0	62.0	60.0	54.0	50.0	48.0	51.0	44.0	31.0	15.0	D, H
7-19-76	1900	MONDAY-EVENING	LMAX	70.0	70.0	68.0	64.0	69.0	54.0	64.0	48.0	40.0	28.0	50.0	D, H
			L50	53.0	60.0	62.0	57.0	57.0	50.0	49.0	45.0	37.0	25.0	16.0	D, H
			L90	52.0	58.0	60.0	56.0	55.0	49.0	48.0	44.0	36.0	24.0	14.0	D, H
			LMIN	52.0	56.0	58.0	54.0	53.0	49.0	48.0	44.0	36.0	24.0	14.0	D, H

TABLE 5-9 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 7*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										NOISE
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	SOURCES**
7-20-76	0311	TUESDAY-NIGHT	LMAX	55.0	62.0	64.0	58.0	52.0	50.0	47.0	44.0	57.0	27.5	15.0	B, F
			L50	52.5	61.0	63.0	57.5	51.5	49.0	46.0	43.5	39.0	27.0	15.0	B, F
			L90	52.0	60.0	62.0	57.0	51.0	49.0	46.0	43.0	38.0	27.0	15.0	B, F
			LMIN	52.0	59.0	61.0	57.0	51.0	49.0	46.0	43.0	37.0	27.0	15.0	
7-20-76	1010	TUESDAY-DAY	LMAX	92.0	70.0	76.0	74.0	61.0	73.0	64.0	56.0	57.0	53.0	22.0	C, F, G, J
			L50	60.0	66.0	67.0	67.0	57.0	58.0	55.0	49.0	42.0	33.0	19.0	C, F, G, J
			L90	57.0	64.0	63.0	62.0	56.0	53.0	54.0	47.0	40.0	30.0	17.0	C, F, G, J
			LMIN	57.0	61.0	62.0	62.0	55.0	52.0	53.0	46.0	40.0	30.0	17.0	C, F, G, J
7-22-76	1915	THURSDAY-EVENING	LMAX	73.0	72.0	68.0	71.0	84.0	75.0	71.0	62.0	61.0	62.0	31.0	B,C,F,J,M
			L50	60.0	60.0	62.5	62.0	61.0	54.0	65.0	49.0	43.0	28.0	15.0	B,C,F,J,M
			L90	56.0	58.0	61.0	60.0	54.0	52.0	52.0	48.0	41.5	27.0	15.0	B,C,F,J,M
			LMIN	56.0	54.0	60.0	60.0	53.0	51.0	51.0	47.0	41.5	26.0	15.0	B,C,F,J,M
7-22-76	2255	THURSDAY-NIGHT	LMAX	71.0	66.0	81.0	67.0	54.0	70.0	59.0	51.0	61.0	32.0	32.0	B, D, F, M
			L50	58.0	58.0	65.0	58.0	52.0	51.0	49.0	47.0	41.5	27.0	16.0	B, D, F, M
			L90	55.0	57.0	63.0	57.0	51.0	50.5	48.5	46.5	41.0	27.0	15.5	B, D, F, M
			LMIN	55.0	54.0	59.0	55.0	51.0	50.0	48.0	46.0	40.0	27.0	15.0	B, D, F, M
8-17-76	0240	TUESDAY-NIGHT	LMAX	53.5	63.0	62.5	58.5	54.0	56.0	49.0	47.0	40.0	29.0	15.0	B, F, I
			L50	53.5	62.0	61.5	58.0	53.5	50.0	48.5	46.5	40.0	27.5	15.0	B, F, I
			L90	53.5	61.0	61.0	58.0	53.5	49.5	48.5	46.5	40.0	27.0	15.0	B, F, I
			LMIN	53.5	61.0	61.0	58.0	53.5	49.0	48.5	46.0	40.0	27.0	15.0	B, F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-10 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 8*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1342	SATURDAY-DAY	LMAX	56.0	64.0	66.0	73.0	60.0	62.0	60.0	53.0	45.0	44.0	35.0	E, F, H, J
			L50	54.0	59.0	64.0	65.0	55.0	47.0	48.0	43.0	41.0	29.0	18.0	E, F, H, J
			L90	51.0	58.0	63.0	64.0	53.0	46.0	45.0	38.0	37.0	28.0	17.0	E, F, H, J
			LMIN	50.0	57.0	62.0	62.0	52.0	45.0	45.0	37.0	36.0	27.0	16.0	E, F, H, J
7-18-76	0425	SUNDAY-NIGHT	LMAX	49.0	56.0	57.0	56.0	50.0	46.0	38.0	40.0	29.0	17.0	14.0	B, F
			L50	43.0	54.0	55.0	52.0	44.0	41.0	37.0	31.0	26.0	16.0	14.0	B, F
			L90	42.0	53.0	54.0	51.0	43.0	40.0	36.0	30.0	25.0	16.0	14.0	B, F
			LMIN	42.0	53.0	53.0	50.0	43.0	39.0	36.0	30.0	24.0	15.0	14.0	B, F
7-18-76	1330	SUNDAY-DAY	LMAX	54.0	64.0	66.0	62.0	60.0	63.0	59.0	60.0	44.0	45.0	17.0	E, F, H
			L50	52.0	62.0	63.0	61.0	56.0	48.0	47.0	45.0	43.0	30.0	16.0	E, F, H
			L90	50.0	61.0	62.0	61.0	55.0	46.0	46.0	44.0	43.0	26.0	16.0	E, F, H
			LMIN	49.0	60.0	60.0	61.0	54.0	45.0	45.0	43.0	43.0	24.0	16.0	E, F, H
7-18-76	1905	SUNDAY-EVENING	LMAX	58.0	60.0	61.0	68.0	64.0	49.0	48.0	56.0	52.0	48.0	16.0	E,F,H,J,K,N
			L50	56.0	58.0	60.0	62.0	53.5	45.0	44.0	43.0	44.0	27.0	15.0	E,F,H,J,K,N
			L90	54.0	57.0	59.0	61.0	52.0	45.0	43.0	42.0	43.0	26.0	14.0	E,F,H,J,K,N
			LMIN	53.0	56.0	58.0	60.0	51.0	45.0	42.0	41.0	40.0	24.0	14.0	E,F,H,J,K,N
7-19-76	1525	MONDAY-DAY	LMAX	68.0	64.0	71.0	63.0	54.0	54.0	54.0	53.0	52.0	42.0	26.0	E,F,H,J,M,N
			L50	54.0	61.0	65.0	59.0	50.0	48.0	47.0	45.0	41.0	29.0	17.0	E,F,H,J,M,N
			L90	53.0	60.0	63.0	58.0	48.0	47.0	46.0	43.0	39.0	27.0	15.0	E,F,H,J,M,N
			LMIN	53.0	60.0	62.0	57.0	47.0	47.0	45.0	42.0	37.0	26.0	14.0	E,F,H,J,M,N
7-19-76	1906	MONDAY-EVENING	LMAX	57.0	67.0	64.0	61.0	59.0	58.0	60.0	58.0	58.0	42.0	18.0	E, F, H, K
			L50	54.0	58.0	60.0	57.0	51.0	48.0	48.0	44.0	42.0	28.0	16.0	E, F, H, K
			L90	52.0	56.0	58.0	56.0	50.0	45.0	45.0	43.0	40.0	24.0	15.0	E, F, H, K
			LMIN	50.0	55.0	56.0	55.0	49.0	44.0	43.0	42.0	34.0	23.0	14.0	E, F, H, K

TABLE 5-10 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 8*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-20-76	0319	TUESDAY-NIGHT	LMAX	50.0	70.0	57.0	71.0	51.0	41.0	37.0	43.0	64.0	16.5	14.0	E, F
			L50	47.0	56.0	56.0	51.0	45.0	40.0	37.0	36.0	28.0	16.5	14.0	E, F
			L90	45.0	54.0	55.0	50.0	44.0	40.0	37.0	35.0	27.0	16.5	14.0	E, F
			LMIN	44.0	54.0	55.0	50.0	44.0	40.0	36.5	35.0	27.0	16.5	14.0	E, F
7-20-76	1019	TUESDAY-DAY	LMAX	66.0	67.0	70.0	74.0	67.0	62.0	62.0	62.0	59.0	47.0	33.0	E, F, G, H
			L50	64.0	65.0	66.0	70.0	65.0	61.0	61.0	57.5	50.0	36.0	29.0	E, F, G, H
			L90	63.0	64.0	65.0	68.0	63.0	60.5	60.0	57.0	49.0	35.5	26.0	E, F, G, H
			LMIN	63.0	63.0	63.0	65.0	63.0	60.0	60.0	57.0	48.5	35.0	24.0	E, F, G, H
7-22-76	1929	THURSDAY-EVENING	LMAX	71.0	69.0	83.0	69.0	72.0	61.0	68.0	49.0	51.0	53.0	33.0	E,F,H,J,M
			L50	52.0	60.0	61.0	62.0	54.0	47.5	45.0	43.0	40.0	30.0	19.0	E,F,H,J,M
			L90	49.5	58.0	60.0	60.0	52.0	44.0	44.0	42.0	36.0	28.0	17.0	E,F,H,J,M
			LMIN	49.0	55.0	59.0	59.0	51.0	44.0	43.0	40.0	36.0	28.0	16.0	E,F,H,J,M
7-22-76	2305	THURSDAY-NIGHT	LMAX	57.0	63.0	70.0	65.0	54.0	49.0	52.0	51.0	38.0	28.0	19.0	E, F, H, M
			L50	52.0	59.0	64.0	57.0	51.0	47.0	45.5	43.0	32.0	22.0	14.5	E, F, H, M
			L90	51.0	54.0	58.0	54.0	49.0	46.0	46.0	42.0	30.0	18.0	14.0	E, F, H, M
			LMIN	51.0	49.0	57.0	54.0	48.0	45,9	45.0	41.0	30.0	18.0	14.0	E, F, H, M
8-17-76	0250	TUESDAY-NIGHT	LMAX	44.0	55.0	55.0	52.0	47.0	45.0	38.0	41.5	26.5	15.0	21.0	F, L
			L50	44.0	52.5	54.5	51.0	46.0	42.0	37.5	40.5	26.5	15.0	14.5	F, L
			L90	44.0	52.5	54.0	50.5	45.5	42.0	37.5	40.5	26.5	15.0	14.5	F, L
			LMIN	44.0	52.0	53.5	50.5	45.0	41.0	37.0	40.0	26.5	15.0	14.0	F, L

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-11 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 9*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1356	SATURDAY-DAY	LMAX	67.0	74.0	74.0	72.0	70.0	67.0	62.0	62.0	52.0	48.0	33.0	C,F,H,I,J,K
			L50	61.0	67.0	64.0	65.0	62.0	56.0	57.0	52.0	41.0	39.0	31.0	C,F,H,I,J,K
			L90	55.0	65.0	62.0	64.0	61.0	52.0	53.0	43.0	40.0	28.0	31.0	C,F,H,I,J,K
			LMIN	54.0	63.0	61.0	63.0	60.0	51.0	51.0	43.0	39.0	28.0	29.0	C,F,H,I,J,K
7-18-76	0434	SUNDAY-NIGHT	LMAX	54.0	68.0	64.0	62.0	58.0	54.0	46.0	40.0	46.0	34.0	19.0	F, I
			L50	54.0	65.0	63.0	61.0	57.0	52.0	45.0	39.0	34.0	33.0	18.0	F, I
			L90	54.0	64.0	62.0	61.0	57.0	52.0	45.0	39.0	33.0	32.0	17.0	F, I
			LMIN	54.0	63.0	62.0	60.0	56.0	51.0	45.0	39.0	33.0	32.0	17.0	F, I
7-18-76	1340	SUNDAY-DAY	LMAX	64.0	76.0	77.0	70.0	64.0	56.0	51.0	54.0	59.0	42.0	22.0	E,F,H,I,N
			L50	58.0	70.0	72.0	67.0	62.0	55.0	50.0	52.0	46.0	36.0	21.0	E,F,H,I,N
			L90	57.0	68.0	69.0	66.0	61.0	54.0	49.0	51.0	44.0	34.0	20.0	E,F,H,I,N
			LMIN	56.0	66.0	68.0	64.0	60.0	54.0	48.0	50.0	42.0	34.0	20.0	E,F,H,I,N
7-18-76	1920	SUNDAY-EVENING	LMAX	62.0	72.0	78.0	72.0	65.0	62.0	60.0	59.0	50.0	43.0	25.0	E, F, H, I
			L50	60.0	70.0	65.0	65.0	64.0	55.0	55.0	51.0	44.0	37.0	22.0	E, F, H, I
			L90	59.0	67.0	64.0	64.0	63.0	54.0	54.0	47.0	42.0	33.0	21.0	E, F, H, I
			LMIN	58.0	65.0	63.0	64.0	63.0	52.0	52.0	46.0	40.0	32.0	20.0	E, F, H, I
7-19-76	1540	MONDAY-DAY	LMAX	66.0	71.0	79.0	76.0	74.0	68.0	64.0	55.0	54.0	42.0	42.0	C, H
			L50	59.0	69.0	72.0	69.0	67.0	56.0	53.0	47.0	45.0	37.0	24.0	C, H
			L90	58.0	68.0	70.0	67.0	65.0	55.0	52.0	45.0	42.0	35.0	22.0	C, H
			LMIN	58.0	68.0	69.0	66.0	64.0	54.0	51.0	44.0	40.0	30.0	20.0	C, H
7-19-76	1915	MONDAY-EVENING	LMAX	68.0	70.0	72.0	68.0	67.0	66.0	60.0	56.0	52.0	44.0	26.0	D, F, H, I
			L50	58.0	65.0	68.0	65.0	58.0	54.0	49.0	46.0	45.0	35.0	20.0	D, F, H, I
			L90	56.0	64.0	66.0	63.0	56.0	52.0	48.0	45.0	42.0	33.0	18.0	D, F, H, I
			LMIN	54.0	63.0	65.0	62.0	54.0	51.0	46.0	44.0	40.0	31.0	17.0	D, F, H, I

TABLE 5-11 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 9*
SOUND PRESSURE LEVELS IN dB re 20 µ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-20-76	0327	TUESDAY-NIGHT	LMAX	58.0	68.0	66.0	77.0	58.0	53.0	48.0	59.0	47.0	31.0	16.0	F, I
			L50	55.0	65.0	64.0	62.5	57.0	52.5	47.0	41.0	35.0	24.0	16.0	F, I
			L90	54.0	64.0	63.0	62.0	57.0	52.0	46.0	40.0	34.0	23.0	16.0	F, I
			LMIN	54.0	64.0	63.0	62.0	57.0	52.0	46.0	40.0	34.0	23.0	16.0	F, I
7-20-76	1028	TUESDAY-DAY	LMAX	67.0	74.0	75.0	77.0	69.0	64.0	66.0	65.0	50.0	47.0	32.0	D, F, I
			L50	62.0	70.0	71.0	69.0	65.0	61.0	56.0	58.0	46.0	39.0	29.0	D, F, I
			L90	61.0	69.0	70.0	68.0	63.0	59.0	54.0	55.0	45.0	34.0	27.0	D, F, I
			LMIN	61.0	68.0	68.0	67.0	61.0	58.0	54.0	54.0	44.0	33.0	26.0	D, F, I
7-22-76	1945	THURSDAY-EVENING	LMAX	65.0	74.0	77.0	68.0	67.0	58.0	54.0	59.0	57.0	41.0	39.0	D, F, I
			L50	60.0	77.0	67.0	65.0	60.0	55.0	51.0	51.0	51.0	35.0	30.0	D, F, I
			L90	56.0	66.0	66.0	62.0	56.0	55.0	51.0	50.0	43.0	34.0	29.0	D, F, I
			LMIN	56.0	62.0	64.0	60.0	55.0	54.0	50.0	46.0	40.0	33.0	29.0	D, F, I
7-22-76	2315	THURSDAY-NIGHT	LMAX	74.0	76.0	71.0	74.0	67.0	59.0	57.0	49.0	54.0	54.0	26.0	E, F, H, I
			L50	60.0	66.0	67.0	65.5	59.5	56.0	53.0	45.0	42.0	29.0	21.5	E, F, H, I
			L90	59.0	65.0	60.0	65.0	59.0	55.0	51.0	44.0	39.0	26.0	21.0	E, F, H, I
			LMIN	56.0	65.0	58.0	64.0	58.0	54.0	50.5	43.0	38.0	26.0	21.0	E, F, H, I
8-17-76	0300	TUESDAY-NIGHT	LMAX	65.0	68.0	65.0	75.0	63.5	58.0	47.0	62.0	35.0	24.0	18.5	F, I
			L50	58.0	65.0	63.0	64.5	63.0	53.5	47.0	44.0	35.0	24.0	18.5	F, I
			L90	57.0	64.0	62.0	64.5	63.0	53.0	47.0	43.0	35.0	24.0	18.5	F, I
			LMIN	57.0	64.0	61.5	64.0	62.5	53.0	47.0	43.0	35.0	24.0	18.5	F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-12 (Sheet 1 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 10*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
7-17-76	1410	SATURDAY-DAY	LMAX	63.0	72.0	70.0	65.0	63.0	55.0	55.0	52.0	49.0	36.0	22.0	F, H, J
			L50	56.0	68.0	68.0	62.0	59.0	52.0	50.0	46.0	40.0	29.0	18.0	F, H, J
			L90	54.0	67.0	66.0	60.0	56.0	50.0	49.0	44.0	38.0	26.0	16.0	F, H, J
			LMIN	53.0	66.0	65.0	59.0	55.0	49.0	48.0	42.0	37.0	26.0	15.0	F, H, J
7-18-76	0447	SUNDAY-NIGHT	LMAX	54.0	67.0	66.0	62.0	53.0	49.0	46.0	46.0	33.0	20.0	14.0	F, I
			L50	52.0	66.0	65.0	61.0	52.0	48.0	45.0	44.0	33.0	19.0	14.0	F, I
			L90	51.0	65.0	64.0	60.0	52.0	48.0	45.0	41.0	33.0	19.0	14.0	F, I
			LMIN	51.0	65.0	64.0	59.0	52.0	48.0	45.0	41.0	32.0	19.0	14.0	F, I
7-18-76	1350	SUNDAY-DAY	LMAX	58.0	74.0	71.0	66.0	57.0	52.0	48.0	54.0	49.0	28.0	15.0	D, F, H
			L50	55.0	68.0	67.0	64.0	56.0	50.0	47.0	45.0	38.0	24.0	14.0	D, F, H
			L90	54.0	66.0	65.0	63.0	55.0	49.0	47.0	43.0	37.0	23.0	13.0	D, F, H
			LMIN	53.0	65.0	64.0	61.0	52.0	48.0	47.0	42.0	36.0	21.0	13.0	D, F, H
7-18-76	1930	SUNDAY-EVENING	LMAX	65.0	70.0	72.0	66.0	59.0	50.0	50.0	52.0	46.0	23.0	16.0	E, F, H
			L50	58.0	67.0	68.0	65.0	58.0	49.0	49.0	46.0	37.0	22.0	14.5	E, F, H
			L90	56.0	66.0	67.0	64.0	55.0	49.0	48.0	45.0	35.0	21.0	14.5	E, F, H
			LMIN	55.0	65.0	66.0	63.0	54.0	49.0	48.0	43.0	34.0	21.0	14.5	E, F, H
7-19-76	1550	MONDAY-DAY	LMAX	63.0	72.0	72.0	70.0	61.0	58.0	58.0	56.0	50.0	48.0	40.0	E, F, H
			L50	59.0	70.0	68.0	65.0	58.0	53.0	52.0	48.0	41.0	32.0	20.0	E, F, H
			L90	58.0	68.0	66.0	64.0	56.0	52.0	50.0	47.0	37.0	31.0	18.0	E, F, H
			LMIN	57.0	66.0	65.0	62.0	55.0	52.0	49.0	46.0	36.0	29.0	16.0	E, F, H
7-19-76	1925	MONDAY-EVENING	LMAX	62.0	70.0	74.0	71.0	62.0	56.0	55.0	68.0	47.0	41.0	26.0	E, F, H
			L50	55.0	66.0	70.0	65.0	56.0	50.0	48.0	46.0	38.0	25.0	15.0	E, F, H
			L90	54.0	63.0	64.0	62.0	54.0	48.0	47.0	43.0	36.0	24.0	14.0	E, F, H
			LMIN	54.0	61.0	62.0	59.0	52.0	47.0	46.0	43.0	34.0	23.0	14.0	E, F, H

*SEE FIGURE 5-2

TABLE 5-12 (Sheet 2 of 2)

TABULATION OF AMBIENT NOISE SURVEY
LOCATION 10*
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										NOISE
DATE	TIME	DESCRIPTION	LEVEL	dbA	31.5	63	125	250	500	1K	2K	4K	8K	16K	SOURCES**
7-20-76	0335	TUESDAY-NIGHT	LMAX	52.0	66.0	66.0	63.0	54.0	49.0	46.0	50.0	34.0	22.0	14.5	B, F
			L50	51.5	65.0	65.0	62.0	53.0	48.0	45.5	42.0	33.5	21.0	14.5	B, F
			L90	51.0	63.0	64.0	61.0	52.0	48.0	45.0	42.0	33.0	21.0	14.5	B, F
			LMIN	51.0	63.0	63.0	61.0	52.0	48.0	45.0	42.0	33.0	21.0	14.5	B, F
7-20-76	1040	TUESDAY-DAY	LMAX	63.0	73.0	76.0	69.0	62.0	57.0	57.0	56.0	45.0	41.0	24.0	F, G, H
			L50	59.0	70.0	71.0	65.0	56.0	52.0	51.0	47.0	40.0	31.0	20.0	F, G, H
			L90	58.0	69.0	69.0	63.0	54.0	51.0	49.0	46.0	39.0	29.0	18.0	F, G, H
			LMIN	58.0	69.0	67.0	63.0	53.0	50.0	48.0	45.0	38.0	29.0	18.0	F, G, H
7-22-76	1955	THURSDAY-EVENING	LMAX	57.0	70.0	72.0	66.0	60.0	57.0	55.0	48.0	40.0	27.0	19.0	E, F, J
			L50	57.0	65.0	67.0	63.0	55.0	50.5	49.0	45.0	36.0	22.0	15.0	E, F, J
			L90	57.0	63.0	64.0	61.0	54.0	50.0	48.5	43.0	35.0	21.0	15.0	E, F, J
			LMIN	57.0	60.0	63.0	59.0	54.0	49.0	48.0	43.0	35.0	20.0	15.0	E, F, J
7-22-76	2323	THURSDAY-NIGHT	LMAX	59.0	72.0	72.0	65.0	57.0	51.0	60.0	46.0	41.0	23.0	18.0	F, J, L
			L50	55.5	66.0	66.0	61.0	54.0	50.0	50.0	44.5	38.5	22.5	14.5	F, J, L
			L90	54.5	61.0	62.0	60.0	53.0	50.0	49.0	44.0	36.5	22.0	14.5	F, J, L
			LMIN	54.0	60.0	62.0	60.0	52.0	49.0	48.0	43.0	36.0	22.0	14.5	F, J, L
8-17-76	0220	TUESDAY-NIGHT	LMAX	53.0	67.0	67.0	63.0	54.0	51.0	51.0	47.0	52.0	28.0	16.0	F, I
			L50	53.0	66.0	66.0	61.0	53.5	50.0	48.0	46.0	38.0	27.0	15.5	F, I
			L90	53.0	65.0	65.0	60.0	53.0	50.0	48.0	46.0	38.0	27.0	15.5	F, I
			LMIN	53.0	64.0	65.0	60.0	52.5	49.5	48.0	45.5	37.0	26.5	15.0	F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-13

TABULATION OF AMBIENT NOISE SURVEY
ELEVATED RECEPTORS
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

DATE	TIME	DESCRIPTION	LEVEL	dbA	OCTAVE BAND (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
8-17-76	0045	LOCATION 11*	LMAX	80.0	77.0	78.0	66.0	68.0	63.0	57.0	56.0	47.0	30.0	17.0	B, F, I
		CHILDREN'S	L50	61.0	72.0	70.0	65.0	64.0	59.0	56.0	52.0	45.0	29.0	17.0	B, F, I
		HOSPITAL	L90	61.0	67.0	68.0	64.0	63.0	58.0	56.0	52.0	45.0	29.0	17.0	B, F, I
		APARTMENT -	LMIN	60.5	65.0	67.0	64.0	62.0	57.0	55.0	52.0	44.0	29.0	16.0	B, F, I
		ROOF (25 STORIES)													
		TUESDAY-NIGHT													
8-17-76	0110	LOCATION 12*	LMAX	60.0	70.0	70.0	65.0	62.0	58.0	56.0	50.0	42.0	33.0	32.0	F, I
		JIMMY FUND	L50	60.0	67.5	69.0	64.0	61.0	57.5	55.0	49.0	42.0	32.0	32.0	F, I
		BUILDING -	L90	60.0	66.0	69.0	64.0	60.0	57.5	55.0	49.0	42.0	32.0	32.0	F, I
		TOP FLOOR	LMIN	59.5	65.0	68.0	63.0	60.0	57.0	55.0	49.0	41.0	32.0	26.0	F, I
		(9 STORIES)													
		TUESDAY-NIGHT													
8-17-76	0140	LOCATION 13*	LMAX	59.0	63.0	66.0	66.0	59.5	55.0	53.0	52.0	43.0	27.0	25.0	B, F, H, I
		HOUSE OF THE	L50	59.0	62.0	65.0	65.0	59.5	55.0	53.0	52.0	43.0	27.0	22.0	B, F, H, I
		GOOD SAMARITAN	L90	59.0	62.0	65.0	65.0	59.5	55.0	53.0	52.0	43.0	27.0	22.0	B, F, H, I
		ROOF (3 STORIES)	LMIN	59.0	61.0	63.0	65.0	59.5	54.0	53.0	52.0	43.0	27.0	21.0	B, F, H, I
		TUESDAY-NIGHT													

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-14

TABULATION OF AMBIENT NOISE SURVEY
ADDITIONAL NOISE SURVEY
(EXISTING PLANT COOLING TOWERS SHUTDOWN)
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										
DATE	TIME	LOCATION*	LEVEL	dBA	31.5	63	125	250	500	1K	2K	4K	8K	16K	NOISE SOURCES**
3-18-77	0130	1	L90	52.0	59.0	58.0	53.0	53.0	49.0	47.0	42.0	28.0	20.0	18.0	F
3-18-77	0140	2	L90	56.0	62.0	64.0	64.0	60.0	52.0	52.0	46.0	34.0	26.0	24.0	D
3-18-77	0152	3	L90	65.0	66.5	66.0	64.5	67.0	62.0	61.5	54.5	49.5	40.0	22.0	F, I
3-18-77	0145	4	L90	61.0	75.0	68.0	65.0	62.0	58.0	56.0	52.0	44.0	31.0	17.0	I
3-18-77	0150	5	L90	58.0	74.0	70.0	68.0	60.0	55.0	52.0	49.0	45.0	30.0	18.0	I
3-18-77	0125	6	L90	54.0	63.0	62.0	59.0	55.0	52.0	48.0	44.0	37.0	28.0	19.0	F, I
3-18-77	0135	7	L90	51.5	59.0	59.0	58.0	53.0	49.5	45.5	39.5	28.0	15.0	13.5	F
3-18-77	0140	8	L90	46.0	51.0	54.5	53.0	47.0	43.0	40.0	35.0	25.0	18.0	13.5	F
3-18-77	0145	9	L90	54.0	58.0	58.0	59.0	56.0	52.0	49.0	37.5	28.0	20.0	13.0	E, I
3-18-77	0149	10	L90	53.5	61.0	62.0	58.0	53.0	51.0	48.5	43.0	34.0	25.0	14.0	E, I
3-18-77	0127	13	L90	58.0	65.0	65.0	63.0	57.5	56.5	54.0	48.0	41.0	25.0	14.0	F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-15

TABULATION OF AMBIENT NOISE SURVEY
ADDITIONAL NOISE SURVEY
(EXISTING PLANT COOLING TOWERS OPERATIONAL)
SOUND PRESSURE LEVELS IN dB re 20 μ Pa

					OCTAVE BAND (Hz)										NOISE
DATE	TIME	LOCATION*	LEVEL	dBA	31.5	63	125	250	500	1K	2K	4K	8K	16K	SOURCES**
3-18-77	0230	1	L90	52.0	60.0	58.0	56.0	53.0	49.0	47.0	40.0	29.0	16.0	16.0	F
3-18-77	0235	2	L90	55.0	61.0	60.0	60.0	58.0	53.0	53.0	50.0	40.0	24.0	24.0	D
3-18-77	0300	3	L90	66.0	68.0	66.0	68.0	69.0	61.0	64.0	58.0	55.0	43.0	30.0	F, I
3-18-77	0240	4	L90	64.0	76.0	73.0	68.0	62.0	59.0	58.0	56.0	47.0	34.0	21.0	B, I
3-18-77	0245	5	L90	71.0	74.0	72.0	70.0	62.0	61.0	66.0	66.0	61.0	53.0	45.0	A
3-18-77	0225	6	L90	54.0	62.0	61.0	62.0	57.0	53.0	50.0	43.0	36.0	23.0	18.0	F, I
3-18-77	0230	7	L90	51.5	56.5	57.0	56.0	51.5	48.5	47.5	42.0	33.0	16.0	13.0	F
3-18-77	0236	8	L90	44.5	51.0	54.0	51.0	46.0	40.5	39.0	36.0	18.5	13.5	13.5	F
3-18-77	0241	9	L90	55.0	59.0	59.0	63.0	62.0	51.0	45.5	38.0	29.5	20.0	13.5	E, I
3-18-77	0248	10	L90	53.0	61.0	60.0	59.0	54.0	51.0	48.0	44.0	35.0	26.5	14.5	E, I
3-18-77	0225	13	L90	58.5	62.0	62.0	60.0	56.0	56.0	53.0	47.0	37.5	27.0	14.5	F, I

*SEE FIGURE 5-2
**SEE TABLE 5-16

TABLE 5-16

TABULATION OF AMBIENT NOISE SURVEY
OBSERVED NOISE SOURCES
KEY

CODE	NOISE SOURCE
A	COOLING TOWERS DOMINATING
B	COOLING TOWERS AUDIBLE
C	HEAVY TRAFFIC
D	MODERATE TRAFFIC
E	OCCASIONAL TRAFFIC
F	DISTANT TRAFFIC
G	CONSTRUCTION EQUIPMENT
H	AIRPLANES
I	HVAC EQUIPMENT
J	CHILDREN
K	BIRDS
L	INSECTS
M	DOGS
N	WIND IN TREES

TABLE 5-17 (Sheet 1 of 4)

TABULATION OF AMBIENT NOISE SURVEY METEOROLOGICAL PARAMETERS

DATE	PERIOD	TIME	SAMPLING LOCATION*	WIND AVE. SPEED (MPH)	WIND AVE. DIR. (°)	TEMPERATURE (°F)	RELATIVE HUMIDITY (%)	BAROMETRIC PRESSURE (IN. of Hg)
7-17-76	SATURDAY-DAY	1316	1	< 2	VARIABLE	80	66	29.77
		1235	2	< 2	VARIABLE	78	79	29.77
		1245	3	3	120	78	77	29.77
		1255	4	3	VARIABLE	79	75	29.77
		1300	5	< 2	VARIABLE	79	72	29.77
		1310	6	< 2	VARIABLE	80	70	29.77
		1330	7	3	VARIABLE	81	64	29.76
		1342	8	3	VARIABLE	81	63	29.76
		1356	9	5	120	82	61	29.78
		1410	10	3	VARIABLE	82	59	29.77
7-18-76	SUNDAY-NIGHT	0335	1	3	VARIABLE	68	56	29.89
		0345	2	3	VARIABLE	68	55	29.89
		0355	3	< 2	VARIABLE	68	57	29.89
		0400	4	3	VARIABLE	68	56	29.89
		0405	5	3	VARIABLE	67	55	29.89
		0410	6	< 2	VARIABLE	67	54	29.88
		0417	7	3	VARIABLE	67	56	29.89
		0425	8	< 2	VARIABLE	67	54	29.88
		0434	9	5	VARIABLE	68	53	29.89
		0447	10	3	VARIABLE	68	53	29.89
7-18-76	SUNDAY-DAY	1305	1	5	VARIABLE	78	43	30.02
		1207	2	5	VARIABLE	76	45	30.02
		1225	3	5	VARIABLE	77	45	30.02
		1244	4	6	VARIABLE	77	44	30.02
		1239	5	4	VARIABLE	78	44	30.02
		1255	6	7	VARIABLE	78	44	30.02
		1315	7	4	VARIABLE	78	43	30.02
		1330	8	3	VARIABLE	78	42	30.01
		1340	9	6	VARIABLE	78	41	30.01
		1350	10	4	VARIABLE	79	41	30.02

TABLE 5-17 (Sheet 2 of 4)

TABULATION OF AMBIENT NOISE SURVEY METEOROLOGICAL PARAMETERS

DATE	PERIOD	TIME	SAMPLING LOCATION*	WIND AVE. SPEED (MPH)	WIND AVE. DIR. (°)	TEMPERATURE (°F)	RELATIVE HUMIDITY (%)	BAROMETRIC PRESSURE (IN. of Hg)
7-18-76	SUNDAY-EVENING	1845	1	4	VARIABLE	79	38	30.04
		1805	2	3	VARIABLE	80	36	30.03
		1816	3	3	VARIABLE	80	36	30.03
		1824	4	5	VARIABLE	80	36	30.04
		1834	5	4	VARIABLE	79	37	30.04
		1839	6	3	VARIABLE	79	37	30.04
		1855	7	3	VARIABLE	79	38	30.04
		1905	8	<2	VARIABLE	78	39	30.05
		1920	9	3	VARIABLE	78	39	30.05
		1930	10	3	VARIABLE	78	39	30.05
7-19-76	MONDAY-DAY	1455	1	4	VARIABLE	88	35	30.10
		1440	2	5	VARIABLE	88	36	30.11
		1430	3	6	VARIABLE	88	36	30.11
		1406	4	6	VARIABLE	88	36	30.10
		1400	5	4	VARIABLE	88	37	30.10
		1417	6	5	VARIABLE	88	36	30.11
		1510	7	<2	VARIABLE	88	37	30.10
		1525	8	3	VARIABLE	88	36	30.09
		1540	9	8	VARIABLE	88	37	30.10
		1550	10	3	VARIABLE	88	37	30.10
7-19-76	MONDAY-EVENING	1850	1	<2	VARIABLE	87	38	30.10
		1806	2	<2	VARIABLE	87	37	30.10
		1820	3	3	VARIABLE	87	37	30.10
		1827	4	<2	VARIABLE	87	37	30.10
		1834	5	<2	VARIABLE	87	38	30.11
		1839	6	3	VARIABLE	87	38	30.11
		1900	7	<2	VARIABLE	86	39	30.11
		1906	8	<2	VARIABLE	86	39	30.11
		1915	9	4	VARIABLE	87	40	30.11
		1925	10	<2	CALM	87	40	30.11

*SEE FIGURE 5-2

TABLE 5-17 (Sheet 3 of 4)

TABULATION OF AMBIENT NOISE SURVEY METEOROLOGICAL PARAMETERS

DATE	PERIOD	TIME	SAMPLING LOCATION*	WIND AVE. SPEED (MPH)	WIND AVE. DIR. (°)	TEMPERATURE (°F)	RELATIVE HUMIDITY (%)	BAROMETRIC PRESSURE (IN. of Hg)
7-20-76	TUESDAY-NIGHT	0237	1	< 2	CALM	77	57	30.14
		0245	2	< 2	CALM	77	57	30.14
		0252	3	< 2	VARIABLE	77	58	30.14
		0256	4	< 2	VARIABLE	77	58	30.14
		0300	5	< 2	VARIABLE	77	58	30.14
		0304	6	< 2	VARIABLE	77	59	30.14
		0311	7	< 2	VARIABLE	77	59	30.14
		0319	8	< 2	VARIABLE	77	59	30.14
		0327	9	< 2	VARIABLE	77	60	30.14
		0335	10	< 2	VARIABLE	77	60	30.14
7-20-76	TUESDAY-DAY	1001	1	5	VARIABLE	86	48	30.13
		0925	2	5	VARIABLE	82	52	30.13
		0935	3	< 2	VARIABLE	83	52	30.13
		0941	4	4	VARIABLE	84	51	30.13
		0949	5	6	VARIABLE	84	50	30.13
		0955	6	3	VARIABLE	85	50	30.13
		1010	7	4	VARIABLE	86	48	30.13
		1019	8	5	VARIABLE	87	47	30.13
		1028	9	7	VARIABLE	88	47	30.13
		1040	10	7	VARIABLE	88	47	30.13
7-22-76	THURSDAY-EVENING	1902	1	5	VARIABLE	67	71	30.28
		1803	2	< 2	VARIABLE	68	71	30.28
		1817	3	4	VARIABLE	68	71	30.28
		1833	4	5	VARIABLE	68	72	30.28
		1845	5	5	VARIABLE	67	72	30.29
		1851	6	3	VARIABLE	67	72	30.29
		1915	7	5	VARIABLE	66	72	30.28
		1929	8	< 2	VARIABLE	66	71	30.28
		1945	9	5	VARIABLE	66	72	30.28
		1955	10	< 2	VARIABLE	66	72	30.28

TABLE 5-17 (Sheet 4 of 4)

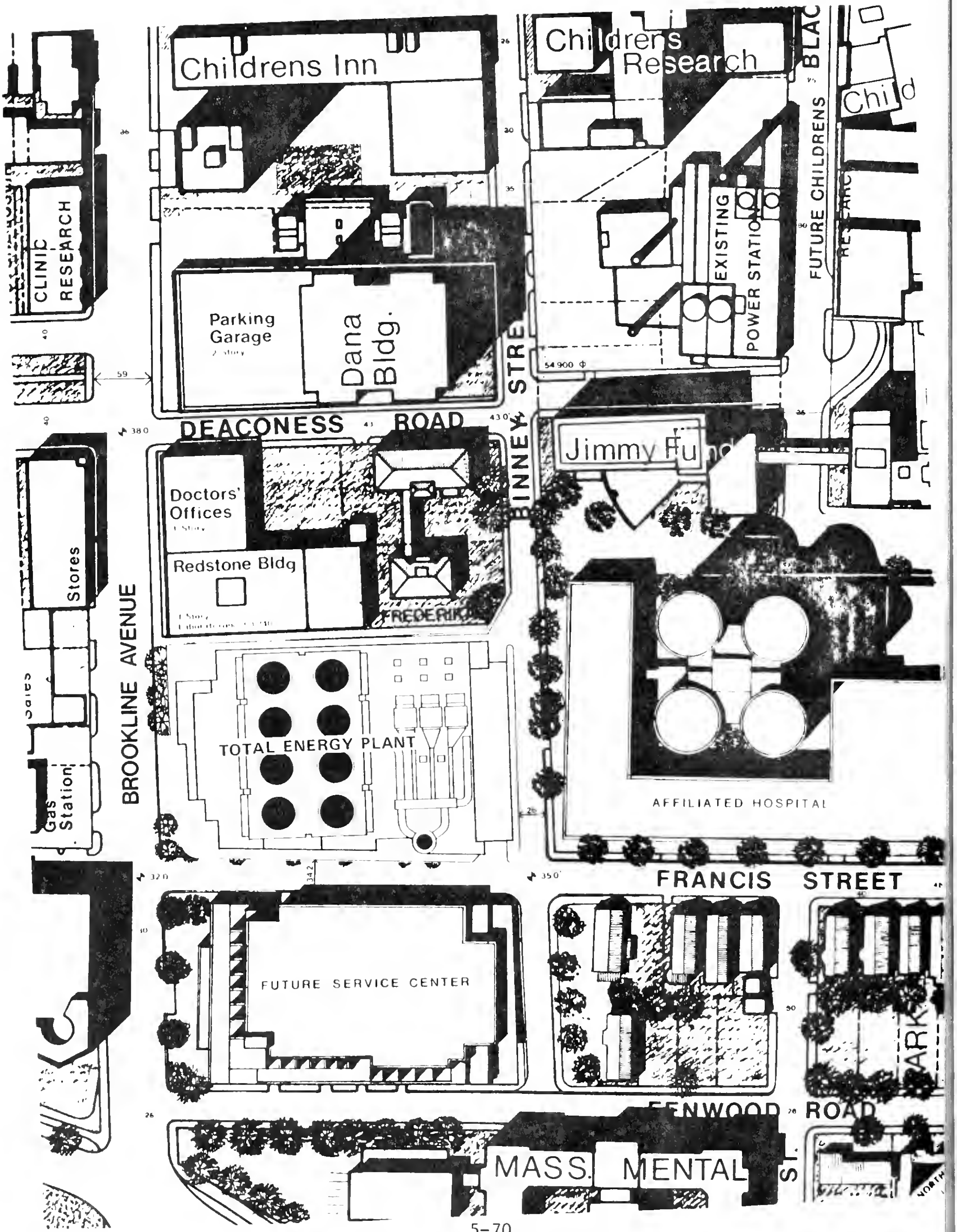
TABULATION OF AMBIENT NOISE SURVEY
METEOROLOGICAL PARAMETERS

DATE	PERIOD	TIME	SAMPLING LOCATION*	WIND AVE. SPEED (MPH)	WIND AVE. DIR. (°)	TEMPERATURE (°F)	RELATIVE HUMIDITY (%)	BAROMETRIC PRESSURE (IN. of Hg)
7-22-76	THURSDAY-NIGHT	2204	1	<2	VARIABLE	63	81	30.28
		2215	2	<2	VARIABLE	63	81	30.28
		2228	3	<2	VARIABLE	63	81	30.28
		2235	4	<2	VARIABLE	63	81	30.28
		2241	5	4	VARIABLE	62	80	30.28
		2247	6	3	VARIABLE	62	81	30.28
		2255	7	3	VARIABLE	62	80	30.28
		2305	8	<2	CALM	62	81	30.28
		2315	9	4	VARIABLE	62	81	30.28
		2323	10	<2	VARIABLE	62	81	30.28
8-17-76	TUESDAY-NIGHT	0200	1	3	270	66	63	29.98
		0207	2	<2	VARIABLE	66	63	29.97
		0225	3	<2	VARIABLE	65	63	29.99
		0231	4	4	280	65	63	30.00
		0235	5	3	270	64	64	29.98
		0145	6	<2	VARIABLE	66	63	29.98
		0240	7	3	285	64	63	29.99
		0250	8	<2	VARIABLE	64	64	29.98
		0300	9	5	270	64	65	30.01
		0220	10	3	280	65	64	30.00
		0045	11	8	270	67	61	29.75
		0110	12	3	270	67	61	29.83
		0140	13	<2	CALM	67	61	29.88
3-18-77	THURSDAY-NIGHT	0115-0300	ALL	<2	VARIABLE	32	50	29.80

*SEE FIGURE 5-2

FIGURE 5-1

PLAN VIEW OF MATEP LOCATION



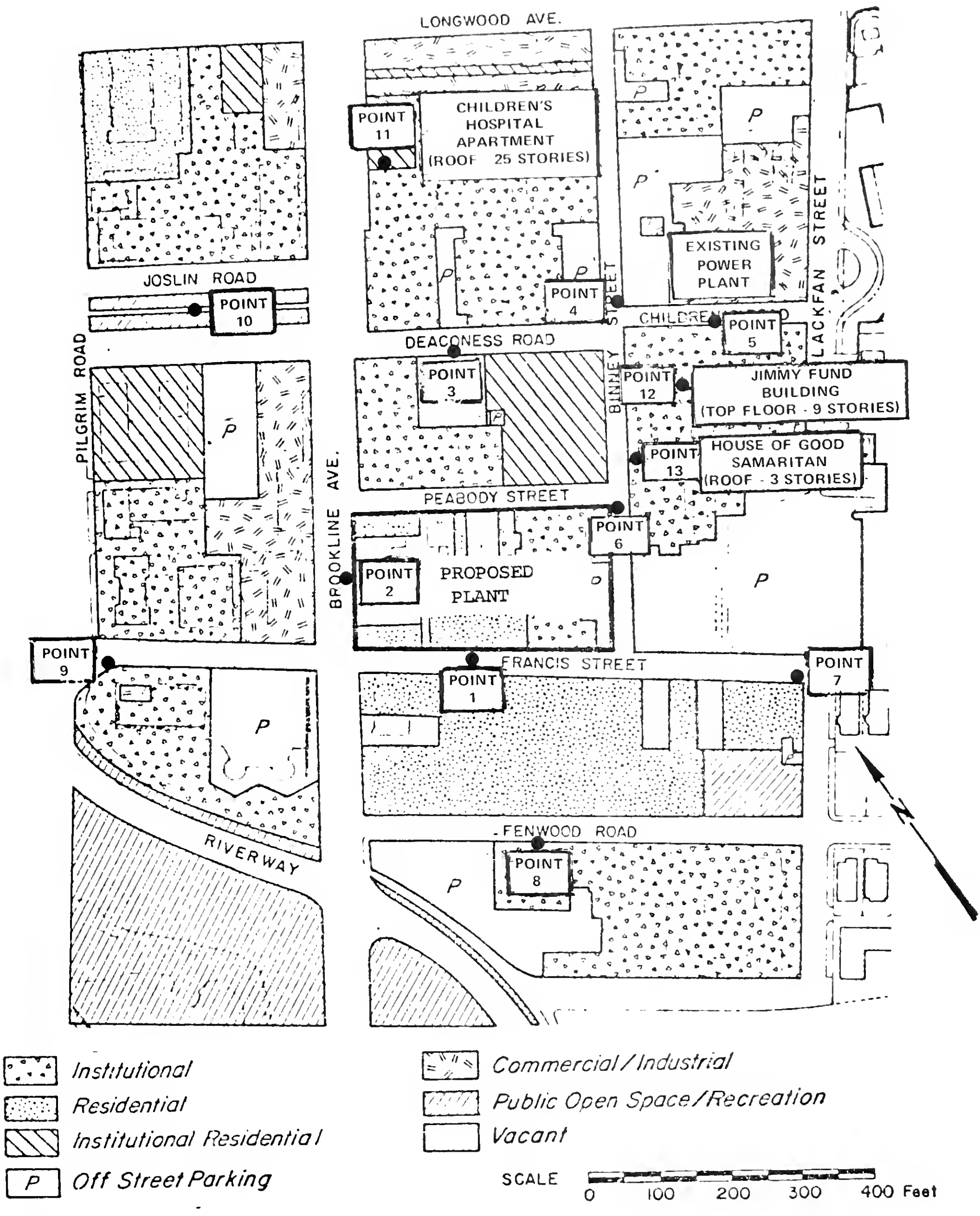


FIGURE 5-2

MATEP NOISE SAMPLING LOCATIONS

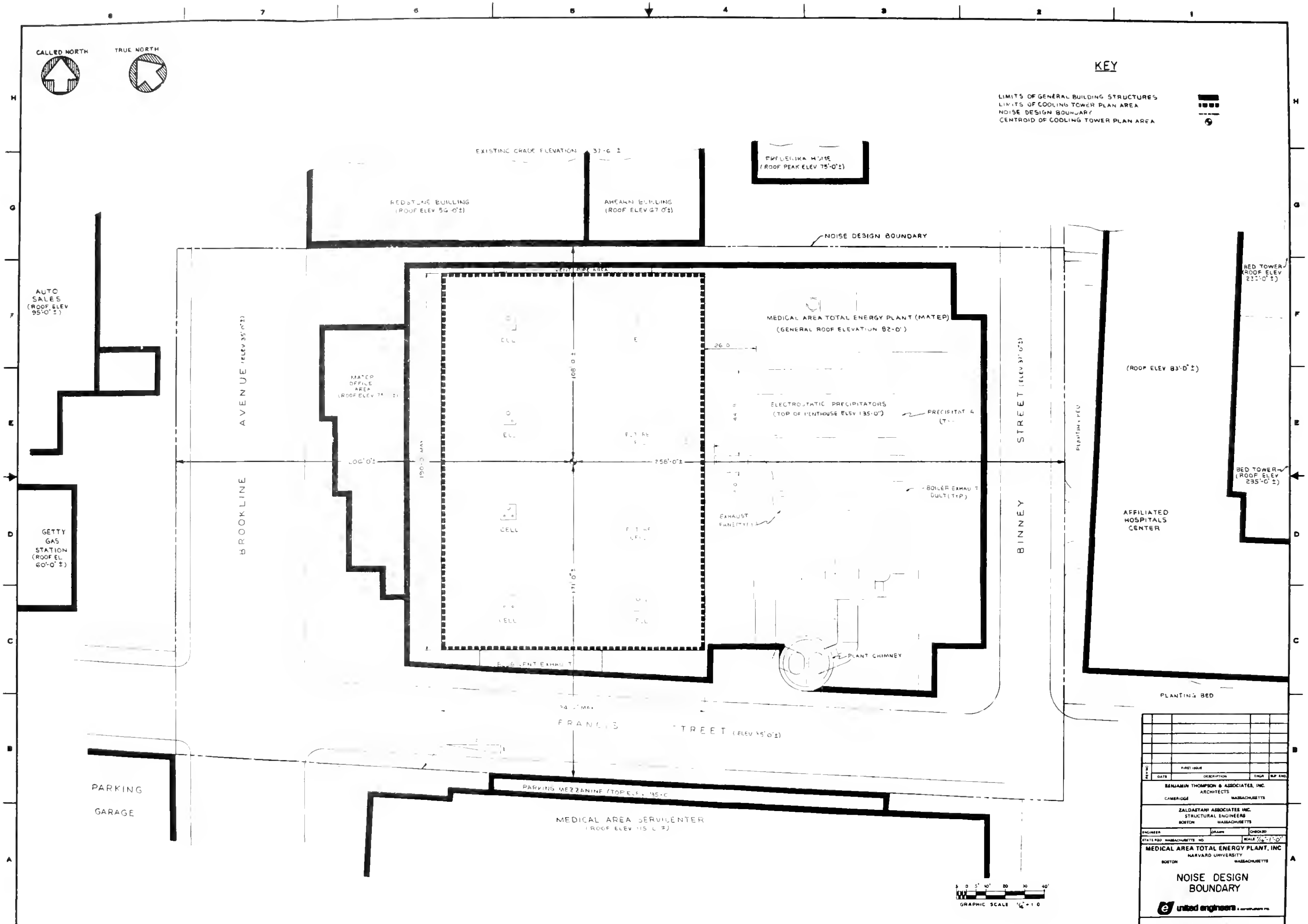
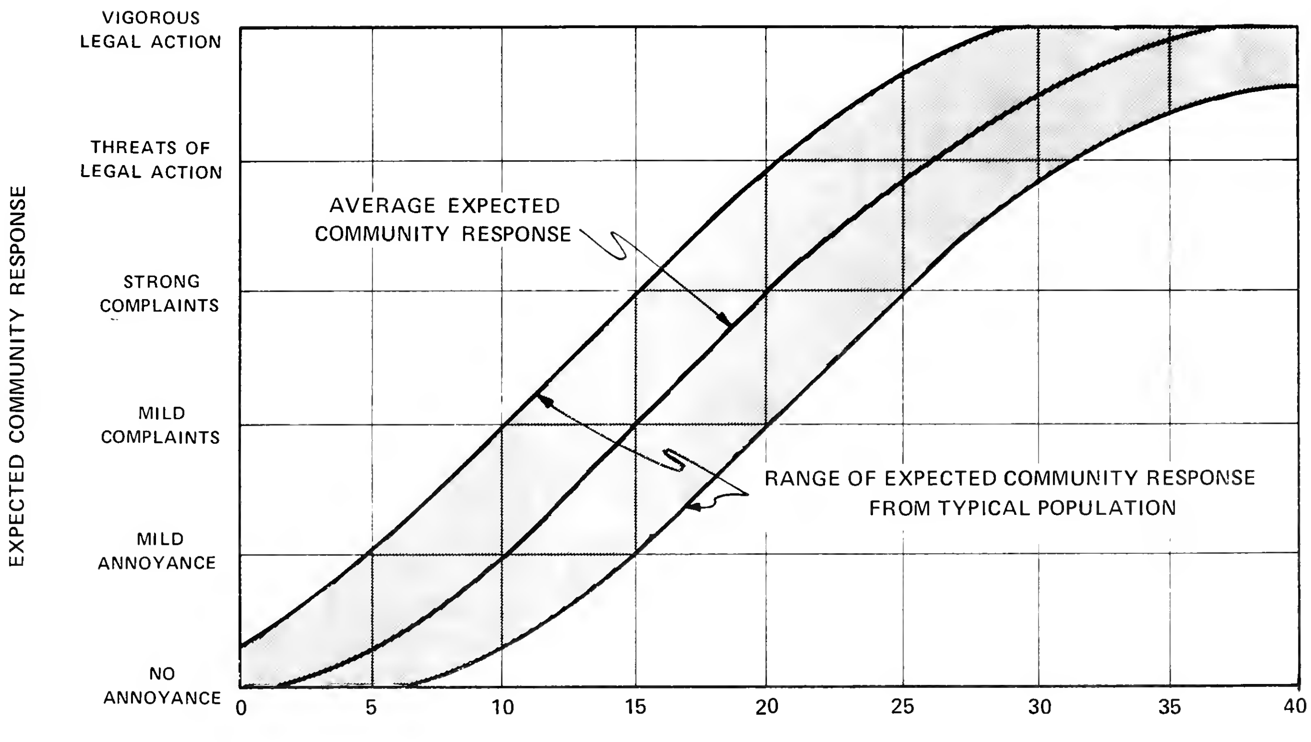

CALLED NORTH
TRUE NORTH
KEY
LIMITS OF GENERAL BUILDING STRUCTURES
LIMITS OF COOLING TOWER PLAN AREA
NOISE DESIGN BOUNDARY
CENTROID OF COOLING TOWER PLAN AREA
NOISE DESIGN BOUNDARY
AUTO SALES (ROOF ELEV 95'-0" ±)
GETTY GAS STATION (ROOF EL 60'-0" ±)
MEDICAL AREA TOTAL ENERGY PLANT (MATEP)
(GENERAL ROOF ELEVATION 82'-0")
ELECTROSTATIC PRECIPITATORS
PLANT CHIMNEY
(ROOF ELEV 83'-0" ±)
AFFILIATED HOSPITALS CENTER
PLANTING BED
PARKING GARAGE
MEDICAL AREA SERVICENTER
BROOKLINE AVENUE
BINNEY STREET
NOISE DESIGN BOUNDARY
united engineers

FIGURE 5-3



EXPECTED COMMUNITY RESPONSE
VERSUS
dBA INCREASE IN EXISTING AMBIENT LEVEL

FIGURE 5-4

SAMPLE CALCULATIONS
PREDICTED SOUND LEVELS ON ELEVATED RECEPTORS
IN THE ENVIRONS OF THE PROPOSED
MEDICAL AREA TOTAL ENERGY PLANT

Reference 1 - Sound Power Levels (PWL) of diesel exhaust provided by Hawker-Siddeley (manufacturer) on letter dated 10-25-76.

Reference 2 - Sound attenuation due to duct runs and bends by L. Beranek, NOISE REDUCTION, 1960, pp. 555-556. Modified by B. A. Bonk for large ducts.

Reference 3 - Directivity corrections from Watters, B., S. Labate, and L. L. Beranek: J. Acoust. Soc. Am., 27:449 (1955). Reprinted by Oliver C. Eckel in paper "Gas Turbine Silencers," ASME Paper No. 63-AHGT-17 and republished in January, 1964, Journal of Engineering for Power, Figure 1.

Reference 4 - Distance attenuation based on standard hemispherical radiation including air absorption loss.

Reference 5 - Attenuation of Model ECX-12096 exhaust waste heat recovery silencer per manufacturer drawing #A-VP-6780-9 for P.O. #018-0014.

Reference 6 - A-weighted corrections from U.S.A. and Europe Standardized response versus frequency of the weighted networks specified in the ASA Z24.3-1944 American Standard on Sound Level Meters and the DIN 5045-1942 German Standard; now ANSI S1.4, 1971.

Hypothetical Worst Case Noise Receptor Due
To Plant Operation Including Stack Noise

The minimum distance from the stack to the noise boundary line at 200 feet above grade would occur along Francis Street directly opposite the stack. The controlling noise due to plant operation results from operation of the cooling towers. To retain the highest degree of conservatism the maximum specified cooling tower noise of 58 dBA at any point on the noise boundary line will be assumed to occur simultaneously at the critical receptor defined for the stack.

Hypothetical Worst Case Sample Calculations

Parameter	Octave Bands (Hz) 63	125	250	500	1K	2K	4K	8K	dBA
PWL diesel exhaust (1 diesel) (reference 1).	156.0	151.0	148.0	146.0	141.0	136.0	136.0	136.0	
Correction for ultimate 9 diesels (10 Log 9).	+9.5	+9.5	+9.5	+9.5	+9.5	+9.5	+9.5	+9.5	
Correction for 579' of duct run including stack (reference 2).	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	
Correction for 11 bends in duct run (reference 2).	-11.0	-22.0	-33.0	-33.0	-33.0	-33.0	-33.0	-33.0	
Corrected PWL out of stack.	148.7	132.7	118.7	116.7	111.7	106.7	106.7	106.7	
Directivity correction 151° to critical receptor (reference 3).	-6.0	-6.0	-6.5	-7.0	-8.5	-10.5	-12.0	-15.0	
Distance attenuation from top of stack to critical receptor 131' (reference 4).	-40.0	-40.0	-40.0	-40.0	-40.0	-40.0	-40.0	-41.0	
Minimum estimated attenuation of afterburners based on data obtained from reference 5.	-23.0	-26.0	-24.0	-22.0	-20.0	-19.0	-18.0	-17.5	
Correction for A-weighting (reference 6).	-26.2	-16.1	-8.6	-3.2	0.0	+1.2	+1.0	-1.1	
Stack noise on critical receptor. (SPL)	53.5	44.6	39.6	44.5	43.2	38.4	37.7	32.1	55.1
Cooling tower noise on critical receptor. (SPL)	52.0	54.0	51.0	45.4	31.7	24.5	40.9	41.3	57.8
			(acoustically sum for total noise)						
Total noise on critical receptor. (SPL)	55.8	54.5	51.3	48.0	43.5	38.6	42.6	41.8	59.7

SPL = Sound Pressure Level = 20 μPa = 2 X 10^{-5} N/m^2 = 0.0002 μ bar = 20 X 10^{-6} N/m^2 = 0.0002 dynes/cm^2

6.0 REVISED TRUCK TRAFFIC ESTIMATES

6.1 Description of Change

Section 4.0, Removal of Incineration Service, discusses in detail the number of trash truck trips necessary for removal of solid wastes. The FEIR estimated the trash truck trips to be 5200 per year for the existing trash removal needs. As discussed in Section 4.0, more precise methodology has shown the actual trash truck trips to be 2600 per year for the existing needs. Improvements are now planned which will reduce this to 1586 truck trips per year. Table 4-2 shows the estimates for various alternative solid waste systems.

Section 8.0, Changes in Fuel Use and Storage, discusses the revised fuel oil delivery requirements. The FEIR estimated that 3890 fuel oil delivery truck trips would be required to bring in the 23,341,000 gallons of oil per year (using 6000 gallon delivery trucks). This represented an increase of about 2000 trips per year over the 1890 trips needed then to bring fuel into the existing plant. Revised fuel estimates indicate that 24,400,000 gallons will be needed. This will require about 4070 trips per year, an increase of 180 per year over the FEIR estimate and an increase of 2120 per year over the existing plant's deliveries as now estimated (1950 per year). Table 3-1 summarizes the various annual truck trip estimates that have been used.

To develop 1980 truck trip estimates the following methodology was used:

Existing trash trips using planned improvements (from Table 4-2)		1586
1980 trash increase (40%)	+.40(1586) =	634
Trash Subtotal		2220
Fuel deliveries for 24,400,000 gallons using 6000 gallon trucks	+	4070
Total 1980 Truck Trips		6290

To develop 1990 truck trip estimates the following methodology was used:

Existing trash trips		1586
1990 trash increase (80%)	+.80(1586) =	1269
Trash Subtotal		2855
Fuel deliveries for 28,500,000 gallons using 6000 gallon trucks	+	4750
Total 1990 Truck Trips		7605

The worst case assumptions are used that there will be no further improvements in the solid waste situation and 8,300 gallon trucks will not be used. Table 6-1 summarizes the estimates for various time periods. In 1980 (post-MATEP) there will be 6,290 truck trips required, an increase of 1,740 per year (or about 4-5 per day) over the 4,550 estimated to be presently operating.

6.2 Impacts of Total Trucks

The impacts associated with the operation of the trash removal trucks in the Medical Area are discussed in Section 4.0, Removal of Incineration Service. Since many elements of the impacts are similar for the fuel oil

trucks and the trash trucks, much of the discussion found in Section 4.0 is repeated here for the combined impacts of the trash trucks and fuel oil trucks.

In assessing the impacts of the trash and fuel oil trucks, it should be kept in mind that trash and fuel oil trucks associated with the solid waste removal system and the existing power plant in the Medical Area are currently operating, and the impacts of these trucks are not new impacts to be imposed on the Medical Area. The reduction of trash truck trips originally planned will not be realized with the removal of incineration service. However, the increase in truck traffic over the existing situation will only be the additional fuel oil trucks. The following discussions consider impacts of both the trash and fuel delivery trucks.

6.2.1 Direct Impact on Air Quality

Heavy duty diesel trucks are a source of air contaminants, primarily carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NO_x). Nitrogen oxides and hydrocarbons (nonmethane) are potentially hazardous through their ability to react in the presence of sunlight, producing photochemical oxidants. However, since this is a process which requires considerable time and, hence, occurs over downwind transport distances on the order of several miles, these pollutants are ordinarily addressed in a regional, rather than local, analysis of air quality impact. The effects of carbon monoxide, on the other hand, are most pronounced at close distances from the source and are, therefore, evaluated locally. The low number of trash and fuel oil trucks in relation to total vehicles in the area makes the trucks minor contributors to the overall level of air quality both on a local and regional basis.

The worst case number of daily trash and fuel oil trucks operating in the Medical Area would be 9 trash trucks per day in 1990 (based on 6 days of pickup per week) and 31 fuel oil trucks per day in 1990 (based on the 24-hr worst case winter fuel consumption) for a maximum daily total of 40 trash and fuel oil trucks in the Medical Area (see Table 6-1). Based on the maximum hourly traffic flow on Brookline Avenue (presented in the Final EIR) of 1,500 vehicles per hour, and the CO emission factor presented in Table 4-5 for 10 miles per hour, the total CO emission rate would be 117,800 grams per mile. Forty trash and fuel oil trucks, based on the 10 mph CO emission factor in Table 4-5, would emit CO at the rate of 1,216 grams per mile, This is less than 1% of the estimated carbon monoxide emission rate for the automobile traffic. It should be recognized that the traffic in the area in the peak morning hour is greater than the 1,500 vehicles measured on Brookline Avenue, and the percentage contribution of air contaminants emitted from the total trucks for trash removal and fuel oil delivery would be considerably less.

ERT has conducted measurements of CO levels in the vicinity of operating trash trucks in the Medical Area, which are summarized in Section 4.2.2. The conclusions of these measurements were that the contribution of trash trucks to local increases in CO levels is negligible. It follows that the impact of the fuel oil trucks on ambient CO levels would also be negligible.

Incremental effects of the trash and fuel trucks on total emissions from motor vehicles in the area for other pollutants are of similar or low magnitude as the negligible CO emissions estimated above.

6.2.2 Traffic Congestion

Due to the comparably small number of trash and fuel oil delivery trucks that are and will be operating in the Medical Area, it is not believed or expected that they are currently or will significantly contribute to traffic congestion in the area. Existing traffic volumes in the Medical Area, as presented in the FEIR, are given for the peak morning hours in Table 6-2. These hourly traffic flows are significantly larger than the weekly trash and fuel oil truck trips given in Table 6-1.

The MASCO Transportation Plan, developed by Charles G. Hilgenhurst and Associates and Wilbur Smith and Associates, November 1975, and discussed in the FEIR, identifies inadequate street capacity during peak hours due to traffic backups from intersections, turns from travel lanes, crossing of rights-of-way, and indirect routes as the major causes of arterial congestion in the Medical Area.

A small number of trucks could cause traffic congestion if they block vehicle movements on busy streets during these peak periods. Such blockage of movements, however, will be prevented as much as possible by the scheduling and operating practices of the trash and fuel oil trucks in the Medical Area.

Under the current solid waste removal system, the trash pickups are made six days per week during the day, with a concentration of pickups in the 7-9 AM period. No trash removal trucks currently operate during the evening rush hour. If it is determined that the morning trash truck operations become a cause of traffic congestion, they could be rescheduled.

The solid waste storage facilities which must be emptied are located off private roads, parking lots, alleys and loading docks of institutions. Therefore, operation of waste pickup would not generally block through roads used

by the public. Illegally parked employee vehicles and delivery trucks interfere with the movements of the trash trucks by blocking access to the storage containers. Trash trucks maneuvering into position to empty storage containers may block movements of vehicles in the streets among the institutions. Every effort will be made, in reviewing the present solid waste disposal system, to eliminate situations where trash truck maneuvers block movements on local streets.

The fuel oil deliveries currently made to the Harvard Medical School Power House are scheduled to avoid both the morning and evening rush hours, and the fuel oil deliveries to MATEP will also be scheduled to avoid the morning and evening rush hours.

The MATEP fuel oil delivery access area will be located on Binney Street, the least busy of the surrounding streets. The access way has been designed to minimize required turning manuevers and to allow quick in and out access for the trucks. It is currently anticipated that the fuel oil trucks will come down Brookline Avenue from Kenmore Square to Longwood Avenue where they will turn left. This is currently a restricted turn and is not permitted between 4 and 6 PM and no deliveries will be scheduled for this period. Trucks will proceed along Longwood Avenue turning right onto Binney Street. The trucks will drive into the unloading area of the site, which is parallel to Binney Street, by means of a curb-cut of Binney Street at the present intersection of Peabody Street. Trucks will leave the power plant by turning right onto Francis Street and then right onto Brookline Avenue.
The MASCO transportation plan and current plans are such that Francis Street wil be widened 8 feet between Binney Street and Brookline Avenue, and restricted parking will be instituted along Francis Street by the MATEP site. These

plans will facilitate the movement of the fuel oil trucks out of the site. It is possible that 6,000 and 8,300 gallon fuel oil trucks may marginally cross the centerline of the widened Francis Street upon leaving the MATEP site. However, since the deliveries will be scheduled to avoid the peak traffic periods, the trucks are not expected to cause any significant traffic congestion.

The MATEP fuel unloading facilities will be able to unload two 6,000 or 8,300 gallon trucks at the same time, with off-street parking for a third truck. The fuel deliveries will be scheduled so that trucks will not have to wait in line outside the plant before entering. Since the fuel oil trucks will be able to unload by gravity in about 30 minutes, during typical average seasonal conditions most or all of the fuel oil deliveries should be able to be scheduled during daylight hours between the morning and evening rush hours. During the winter, some fuel deliveries will be scheduled during the evening after the evening rush hour in order to satisfy the increased fuel oil demands. Table 6-1 provides seasonal estimates of truck traffic.

Concerning the relationship of the trash trucks and fuel oil trucks with the aforementioned MASCO Transportation Plan, it is felt that the operation of the trucks within the Medical Area are not in conflict with the Plan. One of the goals of the Plan, in terms of traffic congestion within the Medical Area, is to relieve congestion during the peak traffic periods by increasing street capacity by methods which include widening and extending certain streets, and developing a Riverway/Brookline oneway couplet system. The trash truck and fuel oil delivery truck operations will be designed to prevent blockage of vehicle movements wherever possible, and hence should not critically impact on the Plan's attainment of the goal to relieve congestion.

One aspect of the plan, with regards to the widening of and parking restrictions on Francis Street, with the provisions for signals at Brookline Avenue, is designed to help facilitate the movement of fuel oil trucks in the Medical Area. If Brookline Avenue is made four lanes northbound and one lane southbound, as proposed in the Plan, and no left turn is allowed from Brookline southbound onto Longwood Avenue, then the fuel oil trucks could use another connecting street, such as Pilgrim Road or Huntington Avenue, to reach Longwood Avenue.

Neither MATEP or the trash removal system are major traffic sources for the area. Their operations will not cause disruption of the present traffic flow patterns nor will they significantly add to the traffic congestion presently in existence. Thus, there will be no secondary air quality impact due to disruption of traffic patterns.

6.2.3 Noise Impacts

Noise levels associated with trash trucks are a function of the type of truck, its mode of operation and the distance to receptors. There are two types of trash truck serving the medical area: the roll off container truck and the compactor truck, each of which spends some time at waste storage areas and some time traveling within the medical area. The pickup of dumpster and bagged waste by compactor type trucks is a relatively noisy operation. Operation of the truck's loader-compactor generated a noise level of 85 dBA at a distance of approximately 50 feet from the truck. Noise levels of this amount are sufficient to preclude ordinary speech communication and would be found sufficiently annoying by most people to cause them to avoid the area of the loading operation.

Unloading a large compactor unit is a much quieter operation. Noise levels at 50 feet of approximately 70 to 75 dBA were measured. The operation of the compactor unit itself is quiet: levels of 75 dBA and less at 5 feet from the compactor and were measured at a number of different units.

The roll off and compactor trucks observed operating within the medical area are diesel powered vehilces, which produce street noise levels varying from 76 to 91 dBA (at a reference distance of 25 feet), depending on whether the truck is idling or undergoing acceleration. Thus, the highest noise levels experienced by pedestrians occurs during the relatively brief period when a trash truck passes. It is expected that the noise levels associated with the passage of fuel oil trucks would be similar to these levels.

6.3 Alternatives and Mitigation Measures

Concerning the alternatives and mitigation measures for the trash trucks, the various options are discussed in Section 4.0, Removal of Incineration Service. Concerning the various options for reducing the number of trash truck trips in the Medical Area, it would appear that recommended improvements to the existing system (see Table 4-2) present a practical approach for relatively easy and quick reduction of the number of trash truck trips in the Medical Area. It is expected that all efforts will be made to coordinate and implement the recommendations of this plan. The option of centralized collection, which would very significantly reduce the number of trash trucks in the Medical Area, however, it not seen as a practical alternative at this time (Section 4.2.5). The various mitigation measures to be employed with regards to any potential traffic impacts of the trash trucks are discussed in Section 6.2.2.

Concerning the various alternatives and mitigation measures for the fuel oil delivery trucks, offsite oil delivery was considered as a potential alternati to direct truck delivery.

An evaluation of offsite oil delivery and storage was completed for a location on the railroad paralleling Columbus Avenue about one mile from the plant site (Roxbury Crossing area). The evaluation included plans for constructi an unloading siding, an underground storage area for 1,000,000 gallons of fuel oil, and underground heated pipeline delivery to the plant site. The economic evaluation showed that this scheme would add an estimated $1,721,500 to the plant capital costs.

During the evaluation, Mr. Anthony Pangaro, Manager of Southwest Corridor Development, was contacted. His letter response indicated that plans for that area call for elimination of potential freight/passenger trains conflicts in favor of passenger service. It has been proposed that existing freight sidings be eliminated. The development of a siding in that area would add some significant cost to the project and would reduce proposed recreation development in the corridor. Further, the Southwest Corridor Plan intends future air rights development that will completely cover the tracks. Any fuel storage or unloadin might be prohibited in such a tunnel.

Other factors considered in the evaluation include the following:

. Disruption associated with construction of a fuel oil supply line running through a residential area.

. Requirement that the direct truck deliveries system be built anyway to allow for reliability of delivery for hospital loads.

. Requirement that No. 6 fuel oil will require heating when delivered by rail because of the prolonged transit not associated with truck delivery.

. Additional operating costs of over $100,000/year.

These considerations led to the conclusion that the minimal impact associated with direct truck delivery is more desirable than the costs and potential problems associated with the rail delivery and off-site storage concept.

If a future oil pipeline for the city is made a component of the Southwest Corridor plan, there could be a tie-in to MATEP. Facilities at MATEP do not preclude the ability to tie into such a pipeline if it is developed. This plan would have the merit of reducing fuel oil delivery traffic throughout the city without relying upon future freight rail development which appears to be inconsistent with present plans.

The various mitigations measures to be employed with regards to any potential traffic impacts of the fuel trucks are discussed in Section 6.2.2.

Another mitigation measure would be the use of 8300 gallon trucks for fuel delivery. MATEP has been designed to accommodate the use of these larger trucks should they be allowed to operate within Boston. This action would decrease the truck trips in Table 6-1 by about 25%, although the noise and air quality impacts of each truck will increase slightly.

TABLE 6-1

REVISED TRUCK TRIP ESTIMATES

	Trash Removal	Fuel Delivery	Total
ANNUAL AVERAGES			
Existing (pre-MATEP)	2600	1890	4490
1980	2220	4070	6290
1990	2855	4750	7605
WEEKLY AVERAGES			
Existing (annual basis)	50	36	86
1980 - Fall	43	70	113
1980 - Winter	43	95	138
1980 - Spring	43	75	118
1980 - Summer	43	75	118
1980 - Annual	43	78	121
1990 - Fall	55	80	135
1990 - Winter	55	110	165
1990 - Spring	55	85	140
1990 - Summer	55	95	150
1990 - Annual	55	91	146
DAILY AVERAGE			
1980	7	16	23
1990	9	18	27
DAILY MAXIMUM*			
1980	7	27	34
1990	9	31	40

*Winter conditions not to be exceeded 1% of the time (based on 5 day per week delivery using 6000 gallon trucks)

TABLE 6-2

MEDICAL AREA TRAFFIC VOLUMES
DURING PEAK MORNING HOURS
AS PRESENTED IN THE FINAL EIR

Brookline Avenue	1500 vehicles per hour
Longwood Avenue	888 vehicles per hour
Huntington Avenue	1400 vehicles per hour
Binney Street	300 vehicles per hour
Francis Street	620 vehicles per hour

7.0 CHANGES IN EQUIPMENT

7.1 Description of Changes

During the detailed design phase of the project, it became apparent that certain changes in plant equipment would have to be made to increase efficiency and reliability. Certain other changes have been required to meet environmental considerations not anticipated during the original planning for the project. The proposed equipment is listed below followed by a summary of the original plans.

Proposed Major Equipment

An outline description of the major equipment is as follows:

1) Six (6) diesel engine generators, 9,600 BHP engines, 6,932 kw, 13,800 volt generators; engines to operate normally on No. 6 fuel oil. No. 2 fuel oil will be used for start-up, low load operation, and shutdown.
2) Two (2) heat recovery steam generators, each 180,000 pounds of steam per hour, 650 psig, 750^{o}F, to operate on diesel exhaust gas after it is passed through a thermal afterburner fired with No. 2 fuel oil.
3) Three (3) package steam generators, each 180,000 pounds of steam per hour, 650 psig, 750^{o}F, to operate on No. 6 fuel oil.
4) Three (3) electrostatic precipitators, one for each package steam generator.
5) One (1) steam turbine generator, 10,300 KW, 125 psig back pressure.
6) Two (2) steam turbine generators, each rated 7,500/11,000 kw, 3,600 RPM, single automatic extraction condensing for inlet steam contitions of 650 psig, 750^{o}F, with automatic extraction at 125 psig, and exhausting to 3.0" HgA; generator rated 13,500 kVA, 0.85 power factor, 13,800 volts.

7) Two (2) centrifugal chillers, each 5,000-ton, with motor drives.

8) Two (2) centrifugal chillers, each 5,000-ton, with condensing steam turbine drives.

9) One (1) centrigugal chiller, 1,900-ton, with motor drive.

10) Six (6) cooling tower cells, each rated 11,000 gpm.

Summary of Original Plans

As previously approved by the BRA, the facility included the following major equipment:

1) Six (6) diesel engine generators.

2) Six (6) waste heat recovery boilers.

3) Five (5) package steam generators.

4) Five (5) cyclones, one for each package steam generator.

5) One (1) steam turbine generator, 10,300 KW, psig back pressure.

6) Two (2) centrifugal chillers, each 5,000-ton, motor driven.

7) Two (2) centrifugal chillers, each 5,000-ton, steam turbine driven.

8) Two (2) refuse incinerators.

9) Six (6) cooling tower cells.

7.2 Addition of Two Extraction/Condensing Steam Turbines

7.2.1 Description of Change

The FEIR included plans for a back-pressure steam turbine driven generator rated at 10,300 KW. Original plans called for steam from the high pressure steam boilers to drive this turbine before being distributed to the institutions at 180 psig.

The inclusion of the thermal afterburner - heat recovery steam generator system (HRSG) as a particulate control device (see Section 7.5.1 below) dictated that, in addition to the back-pressure steam turbine, an extraction/condensing steam turbine generator is required to provide a means for regulating steam production from the HRSG since the afterburner firing and subsequent

steam production are independent of steam demand. The condensing feature of this turbine allows useful recovery of the energy in the unneeded steam, a function which the back-pressure turbine cannot provide. The second turbine is required to insure that a condenser is always available for this regulating function. Additionally, the condensing sections have been sized so that it can serve as an emergency back-up for one diesel generator.

7.2.2 Impact

This action will have environmental effect resulting from a potential maximum 2% increase in plant fuel use if the extraction condensing units are used in place of the back-pressure turbine. This fuel use is reflected in the fuel use analysis in Section 8 and in the air quality analysis in Section 10.

Additionally, the use of the condensing stage of the new turbine will increase the heat load on the cooling towers by less than 5%. This increase does not significantly affect the overall cooling tower impacts.

7.2.3 Alternatives

The requirement for a "heat sink" for the excess steam generated by the thermal afterburner-heat recovery steam generator system dictates that there is no reasonable alternative to this action. This is the only currently available way to dispose of the steam and still recover a maximum amount of energy from it. Other schemes would require that the energy be wasted by venting steam to atmosphere or by condensing steam directly and dissipating all of the energy in the cooling tower.

7.3 Change in the Number of Boilers

7.3.1 Description of the Change

The FEIR included the following boilers:

. Three high pressure steam boilers with a steam production of 180,000 lb/hr at 650 psig and 750^{O}F with a fuel consumption rate of 12,800 lb of No. 6 fuel oil per hour.

. Two saturated steam boilers with a steam production of 180,000 lb/hr at 450 psig and a fuel consumption rate of approximately 10,900 lb/hr.

. Six heat recovery boilers with a total steam production of 94,000 lb/hr.

It is now planned to keep the three high pressure steam boilers and replace all the other boilers with two thermal afterburner-heat recovery steam generators each operating at 180,000 lb/hr of steam at 650 psig. These changes were made to increase the reliability and efficiency of the overall plant cycle and to provide a means for incinerating the diesel engine exhaust to provide particulate emissions control. The decrease in steam capacity is possible because of a decrease in steam demand.

7.3.2 Impact

The proposed change will result in a decrease in the amount of air pollutant emitted from the plant. This is discussed in more detail in Section 10.

Additionally, this change improves the overall plant efficiency by generatin all steams at the higher pressure of 650 psig. This increases the quantity of steam available to generate electricity in the back-pressure turbine generator or the extraction stages of the extraction-condensing turbine generator. This allow a greater portion of the electrical generation to be satisfied by these more economical means of generating electricity. This also results in a reduction in the amount of electricity that would otherwise have to be generated by the diesel generators.

7.3.3 Alternatives

The primary impetus of this change has been the need to provide a reliable and efficient particulate control device for the diesel exhaust. Appendix G discusses the alternatives to this system.

7.4 Addition of 1900 Ton Chiller

7.4.1 Description of the Action

The FEIR included plans for four 5000 ton centrifugal chilled water generators for air conditioning. Two of these units will be driven by steam turbines and two by electric motors.

The proposed change is the addition of a 1900 ton motor driven chiller presently located in the existing Harvard power plant. This chiller will supply the low chilled water demands during the winter months. The smaller chiller will be able to operate near its full load point during the winter months; hence it will be more economical for plant operation. Also, this smaller unit can be used during the summer period to satisfy peak demands more economically than starting a 5000 ton steam driven chiller.

7.4.2 Impacts

This change affects only the internal operation of the plant.

7.4.3 Alternatives

The only reasonable alternative to this action is not to use the chiller. However, the chiller is already owned by Harvard and will increase the efficiency of the plant.

7.5 Change in Particulate Control Equipment

7.5.1 Description of the Change

The FEIR included plans to use multitube cyclone particulate collectors to control particulate emissions from the plant. Using this device, the stated emission rate was 0.05 lbs of particulates per MBtu heat input, the Massachusetts emission standard for new sources.

The proposed change will result in the use of more efficient particulate control devices with a particulate emission rate of about 0.02 lbs of particulates per MBtu. Each of the three package steam generators will have its own electrostatic precipitator which will remove over 90% of particulates during normal operation. Two thermal afterburners in the heat recovery steam generators will remove 85% of the combustible particulates in the diesel exhaust during normal operation.

This equipment has been provided to be responsive to the stated need to obtain maximum particulate removal from new sources in the Boston area.

7.5.2 Impact

The effect of this proposed change will be to decrease particulate emissions from the plant while increasing capital and operating costs. Section 10 discusses the benefit of this reduced emission rate and quantifies the effects of all proposed changes on plant emissions.

7.5.3 Alternatives

Appendix G provides an analysis of the various alternative particulate control devices suudied for MATEP.

The following control methods were evaluated:

Mechanical Collectors (e.g., cyclones)
Scrubbers
Electrostatic Precipitators

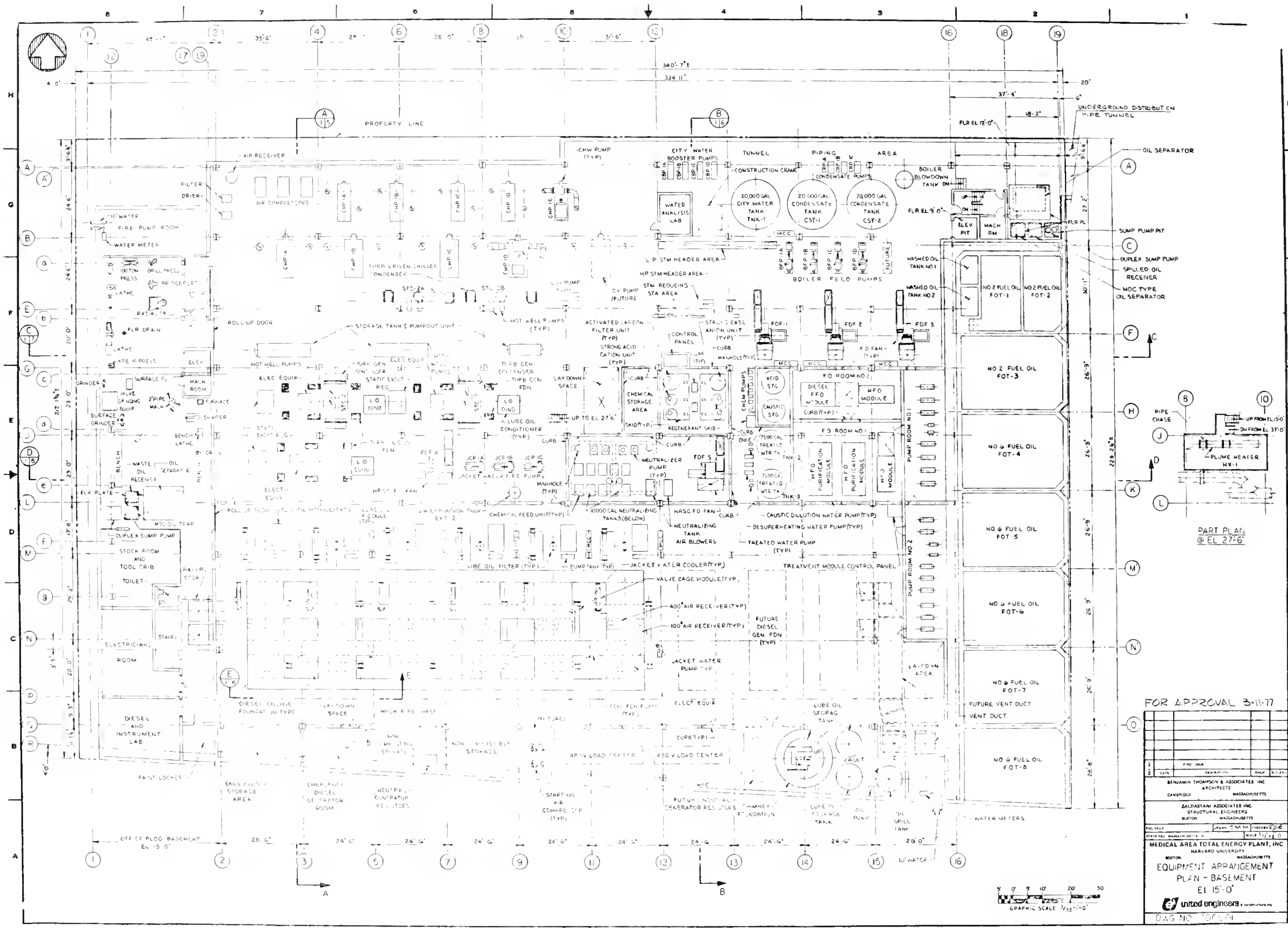
Fabric Filters
Thermal Afterburners
Novel Fine Particle Collection Devices

Electrostatic precipitators were selected for the package steam boilers for the following reasons:

1. Required particulate removal could be achieved.
2. Recent operating experience with electrostatic precipitators on oil-fired boilers has shown they are effective and reliable.
3. Equipment size is consistent with the available plant space.
4. Although initial equipment costs are high, operating costs are relatively low.
5. Precipitators satisfy DEQE's definition of "best available control technology."

Thermal afterburners were selected for the diesels for the following reasons:

1. Required particulate removal could be achieved.
2. There is little experience with any control device on diesel exhaust.
3. The nature of the fine particulates produced by diesels is ideally suited to this type of control.
4. The approach is consistent with the heat recovery cycle needed to achieve high thermal efficiencies.
5. Thermal afterburners are considered the industry to be the best possible control method for diesels.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BENJAMIN THOMPSON & ASSOCIATES INC
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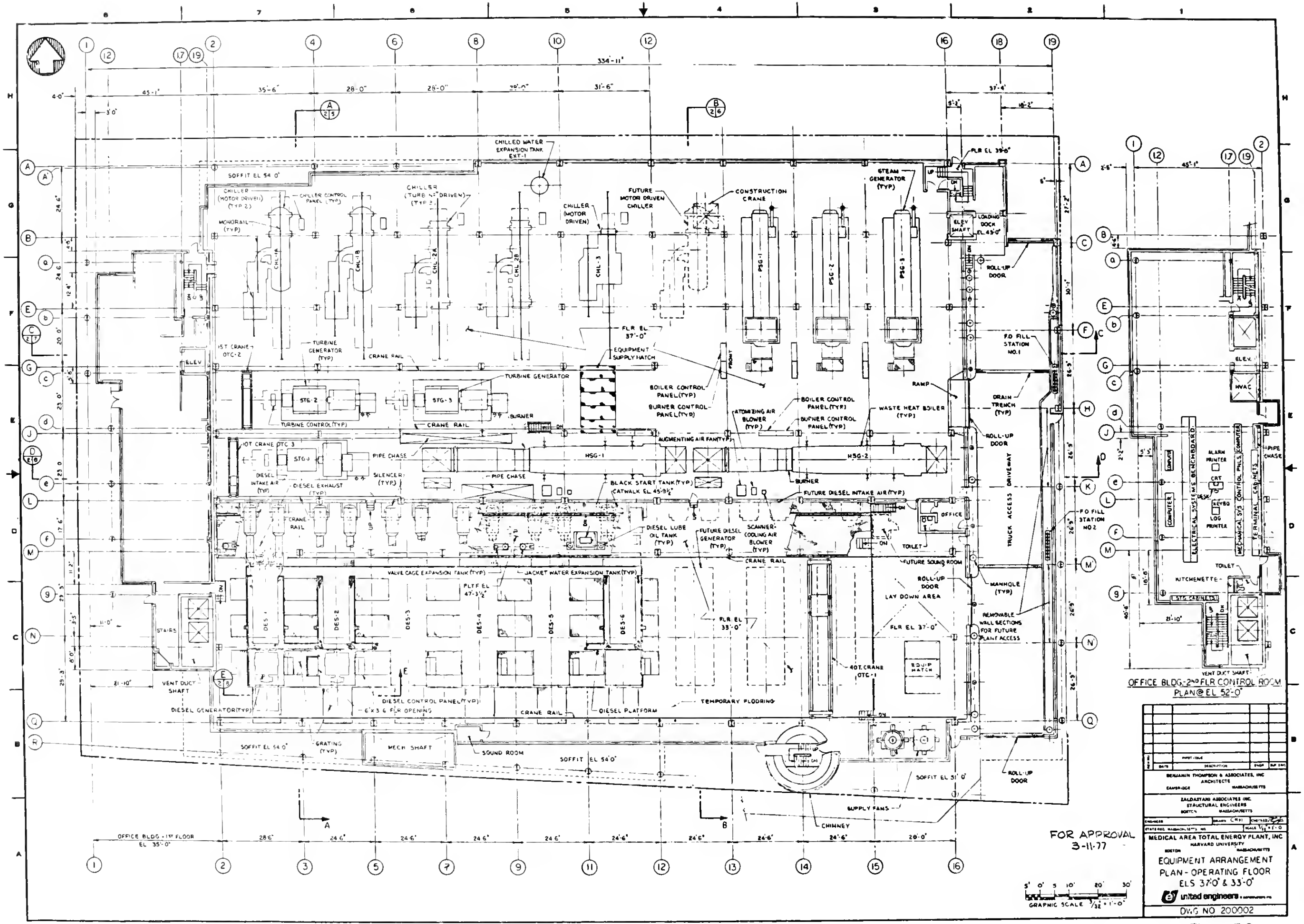
BOSTON MASSACHUSETTS
EQUIPMENT ARRANGEMENT
PLAN - BASEMENT
EL 15'-0"
united engineers
PART PLAN
@ EL 27'-6"
PROPERTY LINE
GRAPHIC SCALE 3/32"=1'-0"

Figure 7-1



CHILLED WATER EXPANSION TANK EXT-1
SOFFIT EL 54'-0"
CHILLER (MOTOR DRIVEN) (TYP 2)
CHILLER CONTROL PANEL (TYP)
CHILLER (TURB. DRIVEN) (TYP 2)
MONORAIL (TYP)
CHILLER (MOTOR DRIVEN)
FUTURE MOTOR DRIVEN CHILLER
CONSTRUCTION CRANE
STEAM GENERATOR (TYP)
FLR EL 39'-0"
LOADING DOCK EL 43'-0"
ROLL-UP DOOR
FLR EL 37'-0"
EQUIPMENT SUPPLY HATCH
1ST CRANE OTC-2
TURBINE GENERATOR (TYP)
CRANE RAIL
TURBINE GENERATOR
BOILER CONTROL PANEL (TYP)
BURNER CONTROL PANEL (TYP)
ATOMIZING AIR BLOWER (TYP)
WASTE HEAT BOILER (TYP)
F.O. FILL STATION NO. 1
RAMP
DRAIN TRENCH (TYP)
TURBINE CONTROL (TYP)
10T CRANE OTC 3
PIPE CHASE
AUGMENTING AIR FAN (TYP)
DIESEL INTAKE AIR (TYP)
DIESEL EXHAUST (TYP)
SILENCER (TYP)
BLACK START TANK (TYP)
CATWALK EL 45'-9½"
BURNER
FUTURE DIESEL INTAKE AIR (TYP)
TRUCK ACCESS DRIVEWAY
OFFICE
TOILET
F.O. FILL STATION NO. 2
DIESEL LUBE OIL TANK (TYP)
FUTURE DIESEL GENERATOR (TYP)
SCAVENGER COOLING AIR BLOWER (TYP)
FUTURE SOUND ROOM
VALVE CAGE EXPANSION TANK (TYP)
JACKET WATER EXPANSION TANK (TYP)
PLTF EL 47'-3½"
ROLL-UP DOOR
LAY DOWN AREA
MANHOLE (TYP)
REMOVABLE WALL SECTIONS FOR FUTURE PLANT ACCESS
FLR EL 33'-0"
FLR EL 37'-0"
EQUIP HATCH
STAIRS
VENT DUCT SHAFT
40T CRANE OTC-1
DIESEL GENERATOR (TYP)
DIESEL CONTROL PANEL (TYP)
6'x3'6 FLR OPENING
CRANE RAIL
DIESEL PLATFORM
TEMPORARY FLOORING
SOFFIT EL 54'-0"
GRATING (TYP)
MECH SHAFT
SOUND ROOM
SOFFIT EL 54'-0"
SOFFIT EL 51'-0"
ROLL-UP DOOR
SUPPLY FANS
CHIMNEY
OFFICE BLDG - 1ST FLOOR EL 35'-0"
334'-11"
ELECTRICAL SYSTEMS BENCHBOARD
MECHANICAL SYS CONTROL PNLS
TERMINAL CABINETS
COMPUTER
ALARM PRINTER
CRT
LOG PRINTER
KEYBD
DESK
KITCHENETTE
TOILET
ELEV.
HVAC
PIPE CHASE
VENT DUCT SHAFT
OFFICE BLDG - 2ND FLR CONTROL ROOM PLAN @ EL 52'-0"
FOR APPROVAL 3-11-77
GRAPHIC SCALE 3/32" = 1'-0"
BENJAMIN THOMPSON & ASSOCIATES, INC ARCHITECTS
CAMBRIDGE MASSACHUSETTS
ZALDASTANI ASSOCIATES INC. STRUCTURAL ENGINEERS
BOSTON MASSACHUSETTS
MEDICAL AREA TOTAL ENERGY PLANT, INC
HARVARD UNIVERSITY
BOSTON MASSACHUSETTS
EQUIPMENT ARRANGEMENT
PLAN - OPERATING FLOOR
ELS 37'-0" & 33'-0"
united engineers
DWG NO 200002

Figure 7-2

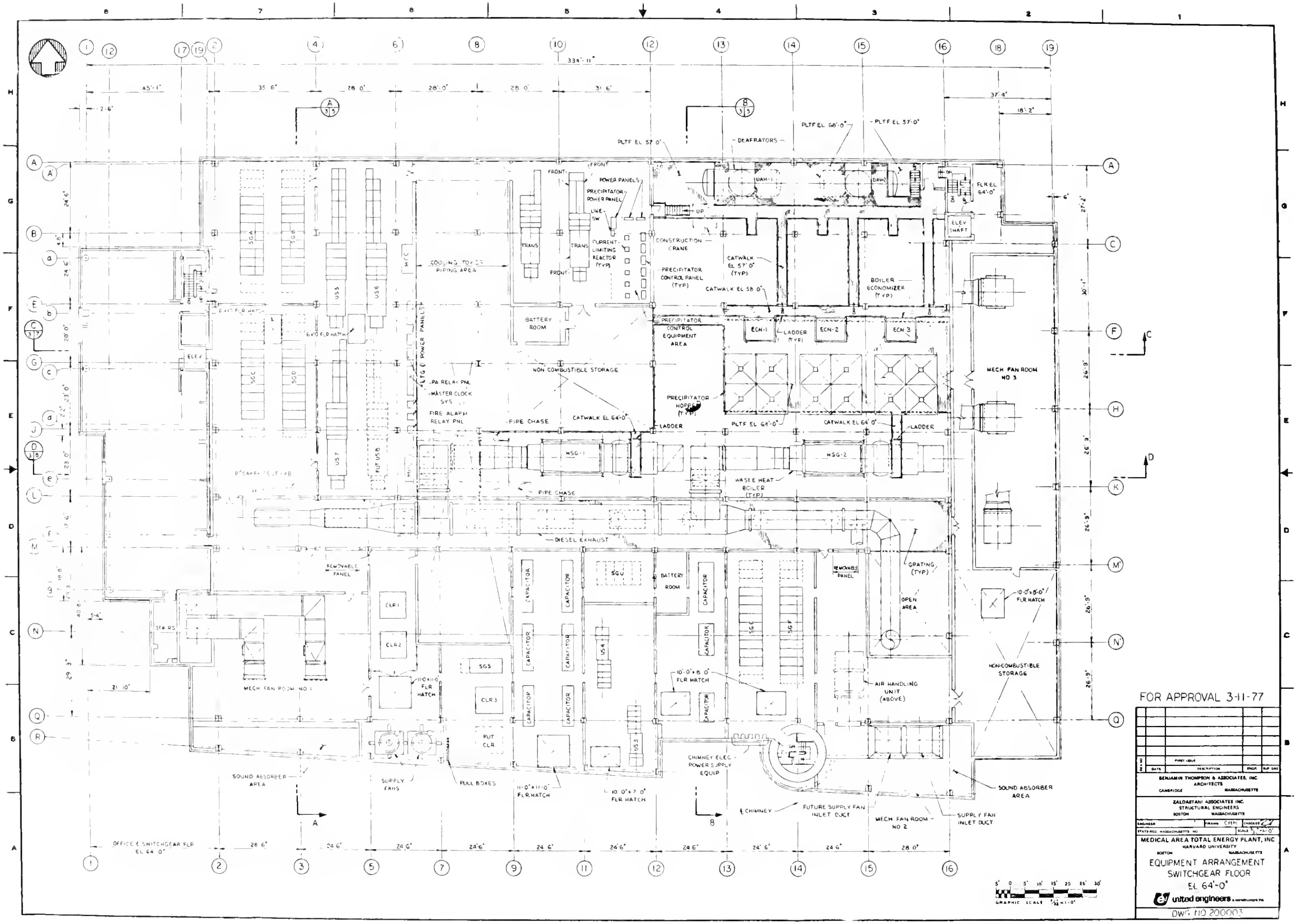
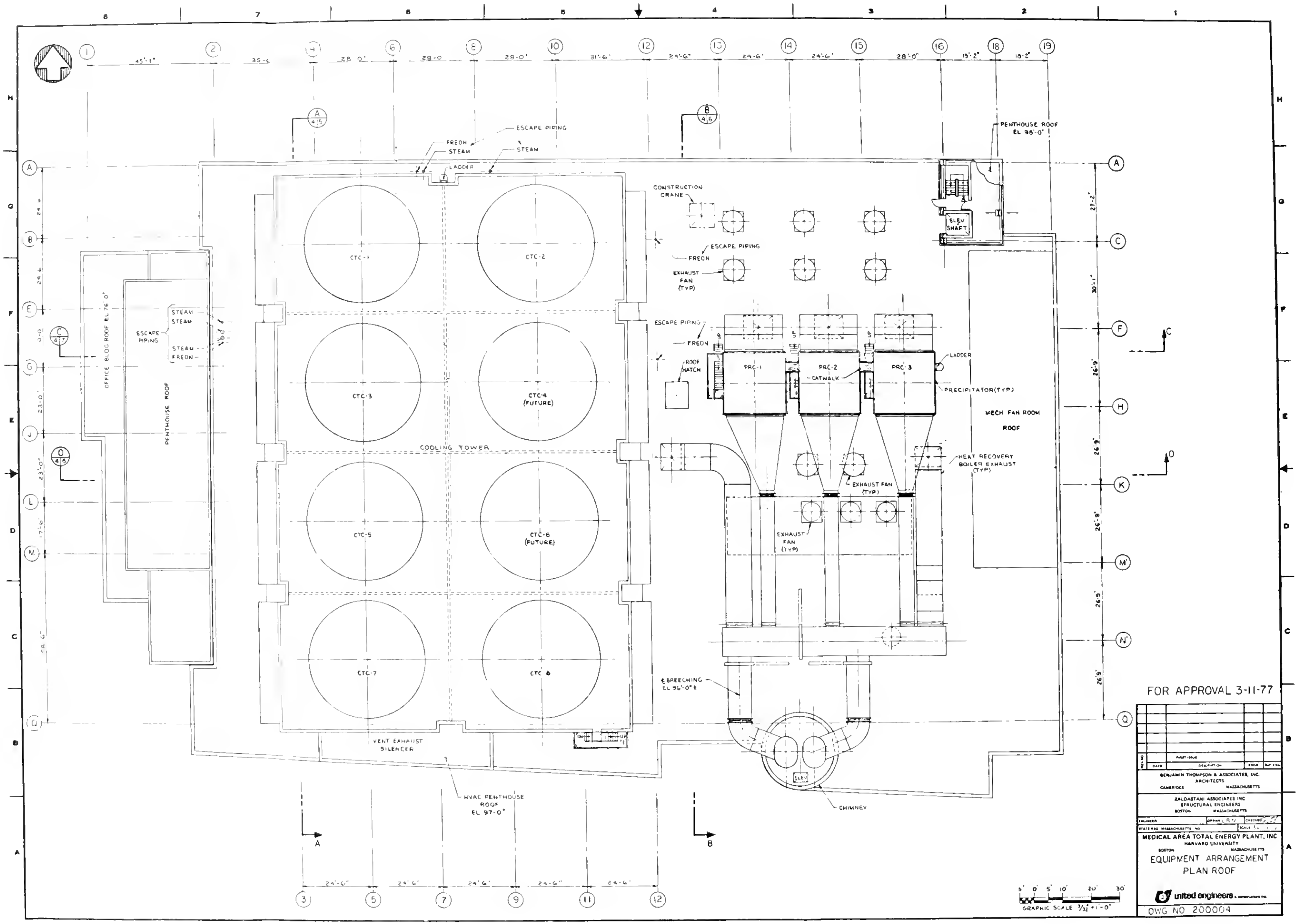

FOR APPROVAL 3-11-77
BENJAMIN THOMPSON & ASSOCIATES, INC. ARCHITECTS
CAMBRIDGE MASSACHUSETTS
ZALDASTANI ASSOCIATES INC. STRUCTURAL ENGINEERS
BOSTON MASSACHUSETTS
MEDICAL AREA TOTAL ENERGY PLANT, INC
HARVARD UNIVERSITY
BOSTON MASSACHUSETTS
EQUIPMENT ARRANGEMENT
SWITCHGEAR FLOOR
EL 64'-0"
united engineers
DWG NO 200003

Figure 7-3



FOR APPROVAL 3-11-77
PENTHOUSE ROOF EL 98'-0"
ESCAPE PIPING
FREON
STEAM
LADDER
CONSTRUCTION CRANE
ELEV SHAFT
EXHAUST FAN (TYP)
OFFICE BLDG ROOF EL 76'-0"
PENTHOUSE ROOF
CTC-1
CTC-2
CTC-3
CTC-4 (FUTURE)
CTC-5
CTC-6 (FUTURE)
CTC-7
CTC-8
COOLING TOWER
ROOF HATCH
PRC-1
PRC-2
PRC-3
CATWALK
PRECIPITATOR (TYP)
MECH FAN ROOM ROOF
HEAT RECOVERY BOILER EXHAUST (TYP)
EXHAUST FAN (TYP)
℄ BREECHING EL 96'-0" ±
VENT EXHAUST SILENCER
HVAC PENTHOUSE ROOF EL 97'-0"
CHIMNEY
ELEV
GRAPHIC SCALE 3/32" = 1'-0"
BENJAMIN THOMPSON & ASSOCIATES, INC.
ARCHITECTS
CAMBRIDGE MASSACHUSETTS
ZALDASTANI ASSOCIATES INC
STRUCTURAL ENGINEERS
BOSTON MASSACHUSETTS
MEDICAL AREA TOTAL ENERGY PLANT, INC
HARVARD UNIVERSITY
BOSTON MASSACHUSETTS
EQUIPMENT ARRANGEMENT
PLAN ROOF
united engineers
DWG NO 200004

Figure 7-4

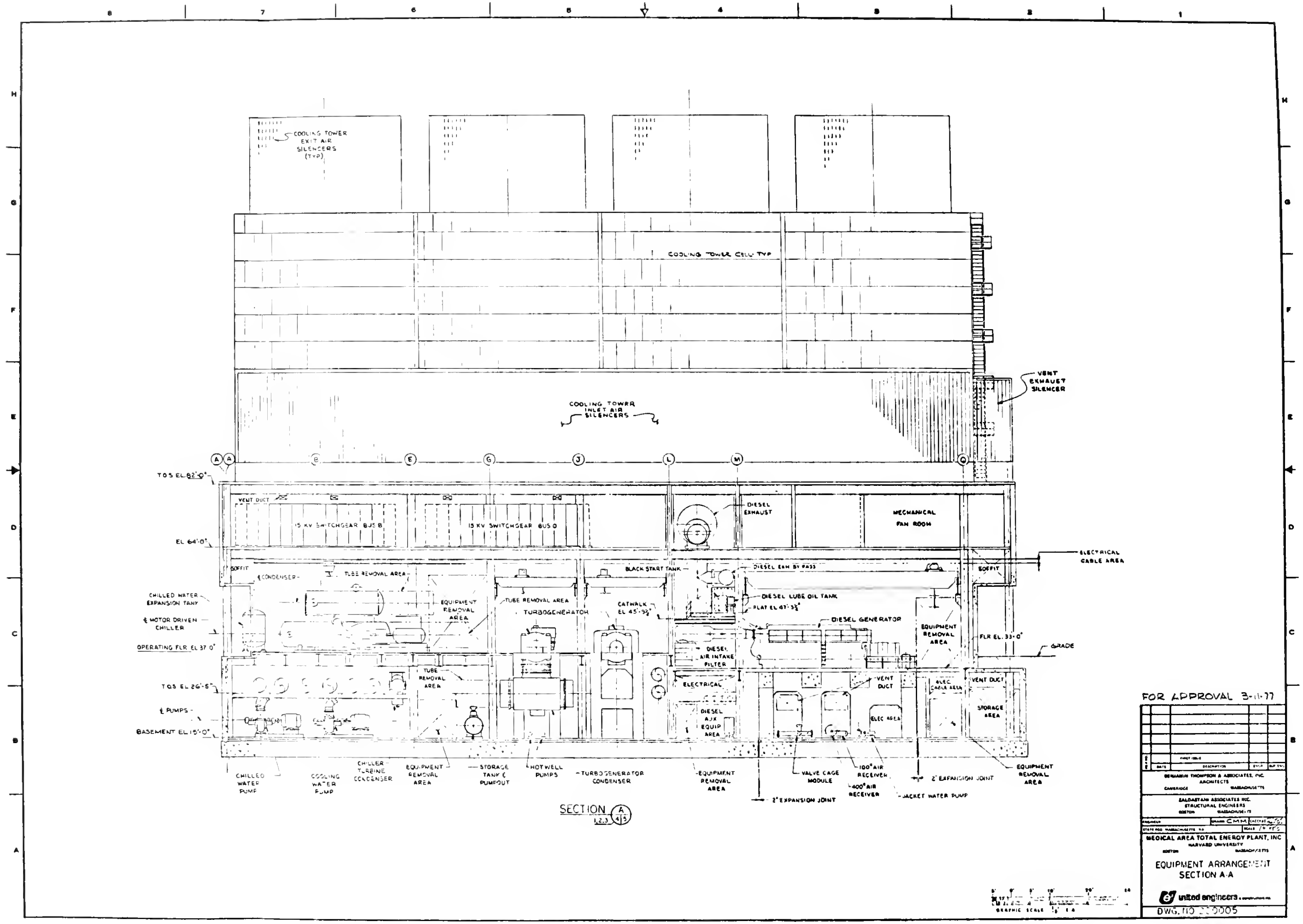

COOLING TOWER EXIT AIR SILENCERS (TYP)
COOLING TOWER CELL TYP
COOLING TOWER INLET AIR SILENCERS
VENT EXHAUST SILENCER
T.O.S. EL. 82'-0"
EL 64'-0"
VENT DUCT
15 KV SWITCHGEAR BUS B
15 KV SWITCHGEAR BUS D
DIESEL EXHAUST
MECHANICAL FAN ROOM
ELECTRICAL CABLE AREA
SOFFIT
CONDENSER
TUBE REMOVAL AREA
BLACK START TANK
DIESEL EXH BY PASS
CHILLED WATER EXPANSION TANK
EQUIPMENT REMOVAL AREA
TUBE REMOVAL AREA
TURBOGENERATOR
CATWALK EL 45'-9½"
DIESEL LUBE OIL TANK
PLAT EL 47'-3½"
DIESEL GENERATOR
MOTOR DRIVEN CHILLER
OPERATING FLR EL 37'-0"
DIESEL AIR INTAKE FILTER
FLR EL. 33'-0"
GRADE
T.O.S. EL 26'-5"
PUMPS
BASEMENT EL 15'-0"
TUBE REMOVAL AREA
ELECTRICAL
DIESEL AUX EQUIP AREA
VENT DUCT
ELEC CABLE AREA
VENT DUCT
STORAGE AREA
ELEC AREA
CHILLED WATER PUMP
COOLING WATER PUMP
CHILLER TURBINE CONDENSER
EQUIPMENT REMOVAL AREA
STORAGE TANK & PUMPOUT
HOTWELL PUMPS
TURBOGENERATOR CONDENSER
EQUIPMENT REMOVAL AREA
VALVE CAGE MODULE
100# AIR RECEIVER
400# AIR RECEIVER
2" EXPANSION JOINT
JACKET WATER PUMP
2" EXPANSION JOINT
EQUIPMENT REMOVAL AREA
SECTION A
FOR APPROVAL 3-11-77
BENJAMIN THOMPSON & ASSOCIATES, INC. ARCHITECTS
CAMBRIDGE MASSACHUSETTS
SALDASTAN ASSOCIATES INC. STRUCTURAL ENGINEERS
BOSTON MASSACHUSETTS
MEDICAL AREA TOTAL ENERGY PLANT, INC
HARVARD UNIVERSITY
BOSTON MASSACHUSETTS
EQUIPMENT ARRANGEMENT
SECTION A-A
united engineers
DWG. NO 2-0005
GRAPHIC SCALE

Figure 7-5

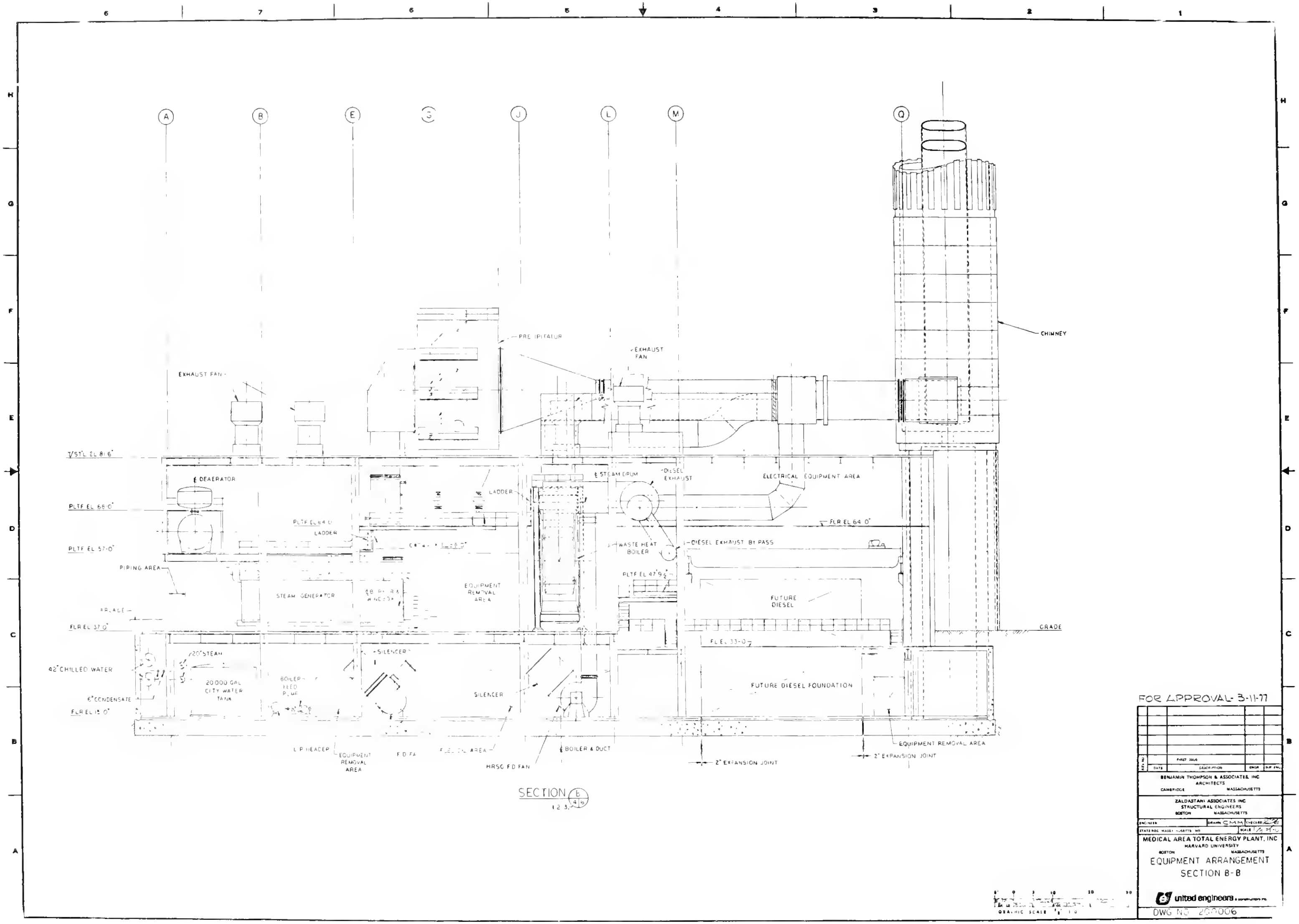

CHIMNEY
EXHAUST FAN
EXHAUST FAN
ELECTRICAL EQUIPMENT AREA
FLR EL 64-0"
DIESEL EXHAUST BY PASS
WASTE HEAT BOILER
FUTURE DIESEL
GRADE
FUTURE DIESEL FOUNDATION
EQUIPMENT REMOVAL AREA
2" EXPANSION JOINT
BOILER & DUCT
HRSG F.D FAN
SILENCER
STEAM GENERATOR
EQUIPMENT REMOVAL AREA
LADDER
DEAERATOR
PLTF EL 68-0"
PLTF EL 57-0"
PIPING AREA
FLR EL 37-0"
42" CHILLED WATER
6" CONDENSATE
FLR EL 15-0"
20,000 GAL CITY WATER TANK
L.P. HEADER
SECTION
FOR APPROVAL 3-11-77
BENJAMIN THOMPSON & ASSOCIATES, INC
ARCHITECTS
CAMBRIDGE MASSACHUSETTS
ZALDASTANI ASSOCIATES INC
STRUCTURAL ENGINEERS
BOSTON MASSACHUSETTS
MEDICAL AREA TOTAL ENERGY PLANT, INC
HARVARD UNIVERSITY
BOSTON MASSACHUSETTS
EQUIPMENT ARRANGEMENT
SECTION B-B
united engineers

Figure 7-6

8.0 CHANGES IN FUEL USE AND STORAGE

8.1 Change in Fuel Use

8.1.1 Description of Change

In August and September of 1976 UE&C reviewed the institutional users' load demands and associated fuel use for MATEP. To accomplish this, a task force of UE&C experts and representatives from MASCO and Harvard met with representatives of each of the users, often a number of times, in developing and finalizing the data.

UE&C requested and obtained detailed data on the size of the facilities, estimates of present energy consumption, and prediction of the future growth in facilities with emphasis on the prediction of the size of the facilities in 1980, 1985 and 1990. Also obtained were data on special situations at the users in regard to energy consumption.

In situations where no data were available, UE&C provided estimates of demand based on the description of facility use and records of comparable facilities. The resulting design demands are presented in Appendix H.

These estimates of demand were then used to prepare load profiles. The load profiles were derived from power plant records for a specific one year span (December 1, 1974 to November 30, 1975) of power which were then adjusted to reflect a typical (30 year average) year on the basis of temperature differences. These profiles were adjusted by the ratio of future demand to the 1975 demands. These load profiles are presented in Appendix H.

These load profiles were then broken down into 192 separate 3 hour averages representing the possible combinations of time - day "instantaneous" demands.

A computer program was developed to facilitate the analysis of the plant cycle and operating modes over the anticipated range of simultaneous utility demands. The program mathematically models the plant cycle and calculates the

optimum (minimum total fuel consumption) selection and loading for the equipment to deliver a given set of simultaneous energy demands.

The order of loading preference for optimum operation of plant equipment was pre-determined from an analysis of the relative efficiencies of various electricity, steam, and chilled water generating machines. In the computer calculation the energy demands are ultimately met by sequentially placing the generating machines in operation in order of the best efficiency until a balance is obtained.

The input for this model was the 192 known different combinations of average energy demands.

All identified operational requirements for the system are met in the computer calculation of optimum loading (including electrical spinning reserve for contingency loss of the largest electrical generating machine), minimum and maximum loading allowed for the equipment.

In addition to the most efficient equipment loadings, the program outputs equipment and plant fuel consumption rates, and individual utility heat rates. Load profiles, equipment performance curves and the preferential sequencing or placing equipment in operation are all basic data within the program.

All of this allows a great degree of confidence in the annual fuel consumption estimates. The revised fuel use estimates in comparison to those originally recorded in the FEIR appear below.

Fuel Use (Gals. per year)

	Initial Demand (1980)	Ultimate Demand (1990)
FEIR	23,341,000	27,076,680
Revised Estimates	24,400,000	28,500,000

This increase of about 5% in fuel consumption is a net increase resulting from refinements in the demand load data, increases in the in-plant energy

requirements for air quality control and noise abatement equipment and increases in the overall plant efficiency due to plant equipment changes.

8.1.2 Impact

This slight fuel increase is not accompanied by increases in air pollutant emissions because of the better particulate control equipment being used and an increase in the relative amount of cleaner No. 2 fuel oil burned in the plant. This increase in No. 2 fuel consumption results from the operation of the thermal afterburner system for control of diesel exhaust. The heat recovery steam generator produces steam which replaces steam from the package steam boilers thereby reducing the No. 6 fuel oil consumption. Section 10 discusses the overall effects of all plant changes on air pollutant emissions.

The increase in fuel use will require additional fuel oil truck deliveries (about 200 more per year or one per day). Truck traffic impacts are discussed in Sections 6 and 10.

8.1.3 Alternatives

The alternative to increasing the fuel consumption of the plant is to remain at the previously estimated fuel consumption estimates. This could be accomplished by decreases in the demands of the users. The users are presently pursuing economical means of conserving energy and as these methods are implemented the actual fuel consumption of the plant will reflect the savings.

A realization of increased plant efficiency could accomplish a reduction in fuel use. Plant economics already dictate that the plant be designed and operated at the most efficient levels. The previously discussed computer analysis will guide plant operation in that respect. Design is directed toward acheiving a high efficiency in plant operation, however it has been necessary to make compromises in plant efficiency to satisfy required air quality control and noise abatement measures.

8.2 Fuel Storage

8.2.1 Description of Change

The FEIR included plans for the following underground fuel storage:

No. 6 Fuel Oil	1,100,000 gallons
No. 2 Fuel Oil	25,000 gallons
Lube Oil	25,000 gallons
Total	1,150,000 gallons

The proposed change is an increase in total fuel storage distributed as follows:

No. 6 Fuel Oil	1,070,000 gallons
No. 6 Fuel Oil, washed	24,000 gallons
No. 2 Fuel Oil	140,000 gallons
Lube Oil	7,500 gallons
Total	1,241,500 gallons

The change is the result of a refined calculation of actual available oil storage space and a re-analysis of the amount of No. 2 fuel oil consumed daily with the inclusion of the thermal afterburners which incinerate the diesel exhaust. The increased storage amounts to 91,500 gallons, less than 10% of the total fuel storage. The washed fuel storage is required to hold the purified oil burned by the diesels.

8.2.2 Impact

The only effect of this increased storage will be a requirement for 15 additional fuel delivery trucks initially to fill the tanks. Since the initial fill of the tanks will be spread out over some weeks, this increase will not be significant.

Increased fuel storage allows the plant to have greater flexibility in scheduling deliveries. This will increase the likelihood that no deliveries will be required during peak traffic hours.

8.2.3 Alternatives

The alternative to this slightly increased fuel storage is to retain the original plant fuel storage. There is no environmental advantage to this alternative.

9.0 CHANGE IN PHYSICAL DIMENSIONS

9.1 Change in Cooling Tower Height

9.1.1 Description of the Change

The FEIR included plans for cooling towers which had a height of 90 feet above grade. The proposed change calls for the maximum cooling tower height to be about 140 feet above grade. Actual cooling towers purchased may not be this high. The height increase is required to allow extensive silencing of the cooling towers to reduce noise levels to the lowest achievable.

9.1.2 Impacts

The change in height will increase the impact of the facility on the aesthetics of the area. Figures 9-1, 9-2 and 9-3 demonstrate the effect of the change in height.

This change will increase the visibility of the plant from most surrounding areas including the Olmstead Park System. Figures 9-2 and 9-3 indicate that other existing and proposed tall structures in the area will be as dominant visually as the plant. The increase in cooling tower height will increase the shadows resulting from the plant but the shadows will still be comparable to those already existing in the area.

The change in height was analyzed as to its potential effect on downwash from the stack. This analysis was completed by Dr. James Halitsky and is presented in Appendix I. The conclusion from his analysis is that this increase in cooling tower height will not affect the stack plume characteristics.

9.1.3 Alternative

The only alternative to increasing the height of the cooling towers is to retain the original tower height. However, this cannot be done if the lowest achievable noise levels are to be obtained. The additional tower height is neede to allow for maximum silencing of the towers. The alternatives to increasing the height to reduce noise levels are discussed in Section 5.6.

9.2 Change in Building-Site Arrangement

9.2.1 Description of the Change

The FEIR included plans for a building-site arrangement which allowed libera open space and pedestrian walkways on Brookline Avenue and Francis Street. Engineering needs, including the requirement for maximum roof space to allow silencing of the cooling towers to the lowest achievable level, dictated that the building take up more room on the site.

The original plan proposed a pedestrian plaza at what is presently Peabody Street of 4980 square feet, 4700 square feet of which would have been open to the sky. This has been decreased to 2000 square feet, about 1800 square feet of whic will be open to the sky. Another area at the intersection of Brookline Avenue and Francis Street was planned to be 3000 square feet (60% open to the sky). Thi will now be 3700 square feet (60% open to the sky). An additional 2400 square fe of open areas have been created at the pedestrian level to include a widening of the paved area along Francis Street, about half of which is open to the sky.

9.2.2 Impacts

Figures 9-1 and 9-2 illustrate the effect of this change upon aesthetics. Sufficient space and architectural treatment is still available to maintain the original intent of the design; that is, to enhance the human scale of the plant at the pedestrian level through extensive use of glass (along Brookline and Francis Street) with arcades, overhangs, landscaped plazas, and the use of brick as the principal exterior material.

9.2.3 Alternatives

The alternative to increasing the building size is to retain the original size of the plant. This would critically restrict proper plant layout and would decrease the roof area available for silencing the cooling towers to the lowest achievable level.

FIGURE 9-1 - ORIGINAL PLANT DESIGN

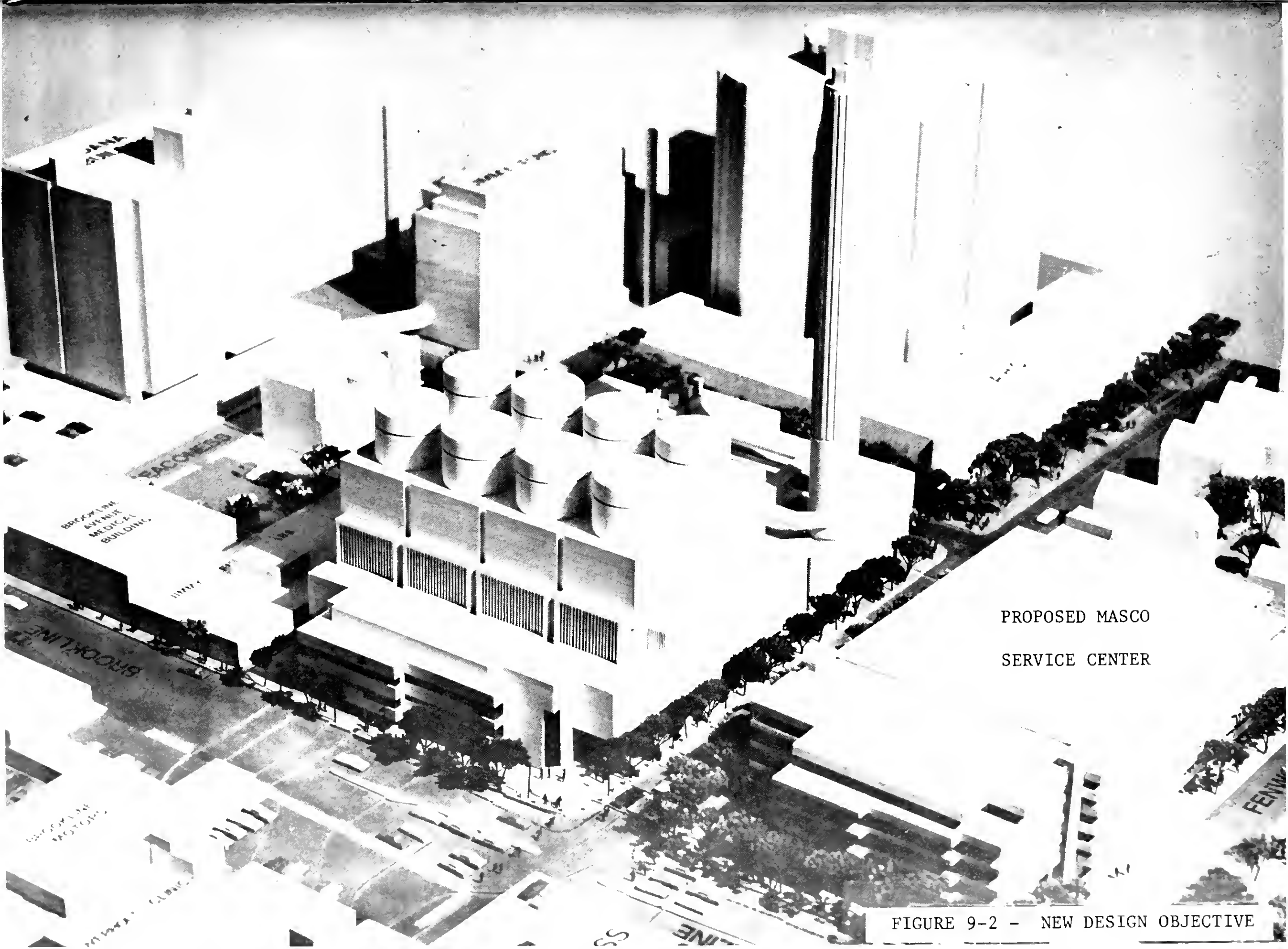


FIGURE 9-2 - NEW DESIGN OBJECTIVE

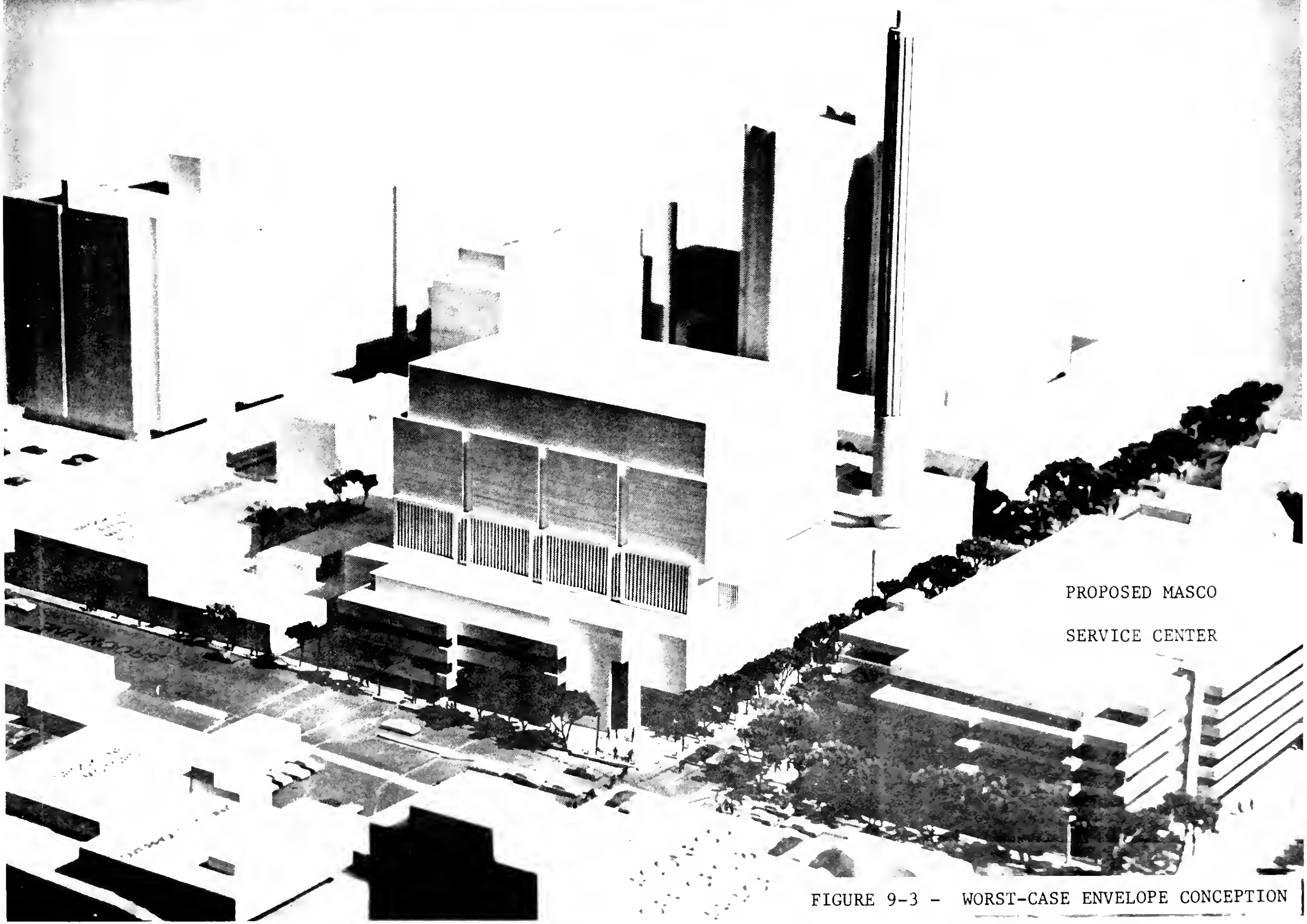


FIGURE 9-3 - WORST-CASE ENVELOPE CONCEPTION

10.0 INTERRELATIONSHIPS OF IMPACTS OF ALL CHANGES

10.1 Air Quality

The changes to MATEP which affect air quality impacts as discussed in the FEIR include the change to more efficient particulate control equipment, the elimination of incineration service, the 5% increase in fuel use, the associated truck traffic increases, and the increase in the height of the cooling towers.

The changes in plant equipment have combined to result in a decrease in particulate and sulfur dioxide emissions and only a slight increase in nitrogen oxides from MATEP as follows:

	FEIR*		REVISIONS**	
Fuel Use (gal)	23,341,000	27,076,680	24,400,000	28,500,000
	1980	1990	1980	1990
Particulates (lb/yr)	207,693	234,777	78,600	95,330
Sulfur Dioxide (lb/yr)	1,833,010	2,233,210	1,678,000	1,950,000
Nitrogen Oxides (lb/yr)	4,855,030	5,630,460	4,845,000	5,907,000

*From Table 1 of "Supplementary Information for the FEIR for MATEP" December 15, 1975, with the incinerator emissions added in.

**Without incineration.

These decreases are realized despite the 5% increase in fuel use because of the use of more efficient control equipment, the removal of the incinerator source, and an increase in the relative amount of cleaner No. 2 fuel oil burned (in place of No. 6 fuel oil) by the thermal afterburner - heat recovery steam generator system. A 5% increase of nitrogen oxide emissions in 1990 over the FEIR estimate is a result of greater use of the diesels than previously predicted.

There are mitigation measures which have potential for reducing the nitrogen oxide emissions below those previously predicted. These methods include fuel injection timing retard, fuel selection and intake air cooling. Potential decreases in emissions using these measures range from 5% to 40% (References 1, 2, 3). MATEP will investigate the effects of these measures during a post-operating study which will establish the operating conditions necessary to decrease emissions. This study will be incorporated into the Plans Approval process.

Since all revised emission rates are lower than those provided in the FEIR (with one exception of a slight increase), the changes do not result in increased impact over that predicted in the FEIR.

The potential effect of the increase in cooling tower height on stack downwa has been analyzed and found to have no effect. This analysis is presented in Appendix I.

The increased truck traffic from trash removal and fuel oil delivery is abo 1740 truck trips per year (4-5 truck trips per day) over the existing conditions An analysis of the carbon monoxide emission rates associated with the peak numbe of trash and fuel delivery trucks expected in the area (Section 6.2.2) shows tha the incremental air quality effects of these trucks are negligible. Neither MAT nor the trash removal system are major transportation sources and neither cause disruptions in the traffic patterns in the area (Section 6.2.3). Thus, secondar air quality impacts due to such disruption will also be negligible.

10.2 Noise

Section 5 provides a detailed analysis of the impact of deviating from the Boston Noise Regulations. That analysis concludes that 60 dBA is the lowest achievable noise level for MATEP. This requires a deviation from the literal

requirements of the Regulations and will result in a 5-6 dB worst-case increase in ambient levels for the critical receptors in the area. This increase is about the level at which increases in noise level first became discernible. That fact combined with the actual nature of the existing environment of the area, indicated that a deviation of this magnitude will not cause significant impact in this particular case.

The other change affecting noise impacts is the predicted increase of 1740 truck trips per year. Section 6.2.3 discusses this impact. Operations and passage of the trash trucks will cause momentary noise levels of 75-91 dB in the vicinity (25 feet) of the truck. Passage of fuel oil delivery trucks will result in similar noise levels. Operations of the fuel oil delivery trucks will be enclosed within the plant.

10.3 Traffic Congestion

There will be an increase of 1740 truck trips per year (4-5 trips per day average) in the area due to refuse removal and fuel oil deliveries. Section 6.2.2 discusses the impacts of the trucks on traffic congestion. The operations of these trucks will be controlled such that there will be no disruption in traffic flow patterns. All impacts will be due only to the incremental number of trucks expected.

10.4 Aesthetics

Section 9.0 discusses the impacts of the changes in the physical dimensions of the plant. Increases in the height of the cooling towers and the building size will increase the aesthetic impact of the plant. Sufficient space and architectural treatment is still available to maintain the original intent of

the design; that is, to enhance the human scale of the plant at the pedestrian level through extensive use of glass with arcades, overhangs, landscaped plazas, and the use of brick as the exterior material.

10.5 Solid Waste Management

The elimination of the incineration service will decrease the life of the Plainville landfill by about 3%. This is about 3-4 months of the present estima 10 year life of the landfill. It will also contribute to the increase in truck traffic discussed in Section 10.3.

MASCO will implement a business plan to centralize control and planning for refuse removal. Short-term steps will reduce the current number of truck trips by 39% and will reduce volume by 20%. This is discussed in Section 4.2.3. The plan will improve the aesthetics, safety and parking space interaction character istics of the refuse removal system. Additionally, MASCO will begin studies and make recommendations to the member institutions on longer-term means of reducing volume by resource recovery and/or front-end separation.

10.6 Water Discharges

MATEP will recycle condensate from the steam supply system back to the plan for reuse. This avoids the discharge of this condensate (plus an amount of cooling water to decrease its temperature) which is the normal procedure. Avoid this discharge decreases plant water demand and discharge. Original plans noted that a discharge of 200 million gallons per year of condensate and 100 million gallons of cooling water would be avoided by this method. MATEP will still use this method; however, since the user steam demands have decreased somewhat the condensate return will now be 157.5 million gallons per year. This merely refle a decrease in the amount of water recycled and does not change the plant dischar

References

(1) Sarofim, A. F. et al, A Report on Nitrogen Oxide Emission Control Technology to National Research Council, November 1974.

(2) Broering, L. C. and Holtzman L. W., Effect of Diesel Fuel Properties on Emissions and Performance, SAE Paper 7406 292, September 1974.

(3) Schaub, F. S. and Berghtel, K. V., NOx Emassions Reduction Methods for Large Bore Diesel and Natural Gas Turbines, Cooper-Bessemer, Mount Vernon, Ohio, ASME Paper No. 71-WA/DAP-2.

11.0 REVIEWS, COMMENTS AND RESPONSES

This report has been prepared to be responsive to the comments received on the previous submittal which was limited to the removal of incineration service. Rather than responding to each comment with an abbreviated response, reference has been made to the complete discussion provided within the text of this report.

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

LYN F. MURPHY
SECRETARY

STATEMENT OF THE SECRETARY
ON
FINAL ENVIRONMENTAL IMPACT REPORT

The Secretary of Environmental Affairs herein issues a statement that the Final Environmental Impact Report submitted on the below referenced project does not adequately and properly comply with Massachusetts preparation of environmental impact reports. My reasons for this statement are set forth in the attached memorandum.

Environmental Affairs File No: 01540A

Submitted By: Boston Redevelopment Authority and Department of Environmental Quality Engineering

Date Received: February 15, 1977

Project Identification: Removal of Incineration Service from the Medical Area Total Energy Plant

24 March 77
DATE

Evelyn F. Murphy
EVELYN F. MURPHY, SECRETARY

EFM/WFMH/arm
cc: Attorney General

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EVELYN F. MURPHY
SECRETARY

MEMORANDUM

TO: Robert F. Walsh, Director
Boston Redevelopment Authority

David Standley, Commissioner
Department of Environmental Quality Engineering

FROM: Evelyn F. Murphy, Secretary
Executive Office of Environmental Affairs

DATE: March 24, 1977

RE: EOEA #01540A, Final Environmental Impact Report
Removal of Incineration Service from the
Medical Area Total Energy Plant

It is my judgement that the Final EIR on the Removal of Incineration Service from the Medical Area Total Energy Plant does not adequately and properly comply with General Laws, Chapter 30, Section 62, and regulations thereunder. My reasons for this statement, set forth in more detail below, center on the need for most environmentally sound solid waste management program for the MASCO institutions and ambiguity in the report on future traffic due to the facility. A new report will be required.

At the outset, I wish to clarify my view as to the nature of the report required on a plan change to a project which has previously been the subject of a Final Environmental Impact Report. This issue has been the subject of some comment during the review of the report and a clear statement as to the standards which apply will guide the Authority and the Department in preparing a new submission and will guide other project proponents who may someday face a similar situation.

Projects which do require environmental impact reports are frequently major projects which have not and indeed cannot be expected to have been fully designed at the appropriate early point in planning when an impact report should be completed. Frequently, the report process will elaborate constraints on design necessary to protect and enhance environmental quality. Subsequent to the report a balancing process is required and changes inherent in this process will normally not require further formal reports as long as the basic constraints continue to be met. But, where a plan change is likely to cause a new or additional level of environmental harm or to foreclose the attainment of an environmental benefit originally planned for, a supplemental report is clearly required.

Such a report need not normally involve a total recapitulation of all aspects of the underlying project. It should be focussed on the changed element of the project and should trace the implications of the change on the environmental consequences of the project in a systematic manner. At a minimum, the significant impacts of the original project and the changed projects should be compared directly.

Turning to the subject report, the major direct impact of the proposed change - removal of incineration from the total energy plant - is in the area of solid waste disposal. The original impact report emphasized as a benefit of the project the fact that significant reduction in truck traffic for waste collection would ensue as a result of the on-site incineration proposal. The claimed reduction in waste related traffic was used to offset increased truck trips for fuel delivery as part of the demonstration that total traffic related impacts would not be significant in comparison with the status quo. Further, the original report pointed to the reduction in use of sanitary landfills as a benefit of the project.

While it is not disputed that removal of incineration will be a beneficial change in terms of air quality impacts from operation of the energy plant, the change does amount to the loss of a major environmental benefit and the implications of this loss merit through consideration - including the analysis of alternative solid waste management programs and the selection of and commitment to that program which offers the best opportunity to mitigate adverse consequences. I believe that both the Authority and the Department have an obligation to ensure that this is done. 1

In this regard, it is worth noting that the Final Environmental Impact Report on the Affiliated Hospital Center project (EOEA #01772) submitted by the Department of Public Health and the Massachusetts Health and Educational Facilities Authority asserted that solid waste would be handled by incineration at the MASCO facility. Thus, the proposed change - removal of incineration - is in effect a change in the Affiliated Hospital Center Project, which may warrant further filings by the agencies there involved.

A major shortcoming of the present report is the inadequate consideration of alternative waste disposal programs. The "no-action" alternative, the only alternative adequately considered leaves no opportunity for enhancement of the existing solid waste management practices carried out at the MASCO facilities. This is also documented in the report, -. "Thus, even though the existing waste situation could be continued without creating environmental damage, there are ways to improve it." - Since means to upgrade present waste collection systems, besides a pneumatic system, are available, the new report should be far more extensive. 2

In the report it is stated that by the year 1990 the MASCO facilities will be generating twice the amount of solid waste currently generated. It would appear that a program of waste volume reduction is highly desirable. This would not only help increase the short lifetime expectancy of present sanitary landfills but also resolve the dilemma of creating larger sanitary landfill areas in the near future. I believe that an effective program for collecting waste papers, aluminum and glass for recycling could reduce total waste by more than 40 to 45 percent while generating adequate revenues to support the program. In view of this, source separation programs and front end material separation and/or recovery merit special consideration. 3

Many of the concerns expressed in the report over the existing waste collection system are valid and noteworthy. Although the report has throughly investigated and highlighted several undesirable problems that persist with the present system, very little effort is made to resolve them. In the first place, neither any specific plans nor appropriate provisions are made to resolve the existing overlapping situation of container sites and auto-parking spaces. Secondly, the problem of litter escaping from the storage containers needs to be resolved. In light of these concerns, I believe, further consideration should be given to eacy access to storage containers, fence installation and/or containers in closed quarters. In addition, to enhance theaesthetic values of the area, construction of new hidden container sites should also be considered in the new report. 4

The new report should also briefly explain total truck trips currently expected to be generated by the facility both with and without incineration. The number of waste collection trips and the number of fuel delivery trips should be stated in comparible terms - e.g., per week or per day. The assumptions used in arriving at these figures should be clearly stated. Alternative waste collection systems should be compared from the point of view of truck trip reductions as well as other factors, including noise reduction measures. 5

I appreciate that MASCO is aware of and committed to improving solid waste handling procedures in the medical area. Letter from Rudman J. Ham, February 15, 1977. More than simple expressions of commitment are needed. The Authority should clearly consider requiring a firm plan with a timetable as part of its approval process and the Department should be in a position to make affirmative findings on this aspect of the project when acting to approve the facility. 6

It is clear from the comments that I have received during this review process, and from other communications, that other elements of the project may also be changing as the result of more detailed engineering work since the old final report and supplement was filed. While I do not believe that all proposed changes would require a further report or that if several changes are proposed they need always be considered together in a supplemental report, I believe it is clearly preferable to proceed with a thorough supplementary report when a series of changes are contemplated. This is particularly the case when at least one change - removal of incineration - is close to the heart of the original raison d'etre of the project.

I understand that the Authority and the Department have recently agreed to prepare another report on proposed changes to the noise constraint the facility was to have been subject to. It is my opinion that that report and the new report on the removal of incineration should be integrated and submitted as one document. 7

For the information and consideration of the Authority and the Department, I am enclosing copies of the comments received during the review period.

EFM/WFMH/arm
Enclosure
cc: Attorney General
Commissioner Fielding, DPH
Mass Health and Educational Facilities Authority

BOSTON EDISON COMPANY
800 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02199

. SULLIVAN
PRESIDENT

March 11, 1977

Secretary Evelyn Murphy
Executive Office of Environmental Affairs
Leverett Saltonstall Building
100 Cambridge Street
Boston, Massachusetts 02202

Att: MEPA Unit

Re: Final Environmental Impact Report on the Removal of Incineration Service From the Medical Area Total Energy Plant dated February 15, 1977 (Document P-2858) EOEA No. 01540

Dear Secretary Murphy:

Boston Edison Company has reviewed the Final Environmental Impact Report on the removal of incineration service from the proposed Medical Area Total Energy Plant, dated February 15, 1977, filed with the Executive Office of Environmental Affairs by the Boston Redevelopment Authority and by the Department of Environmental Quality Engineering.

We wish to call to your attention that the analysis in the Report of the overall traffic impact of the proposed Total Energy Plant with the elimination of the proposed incinerator from the Plant is inadequate.

The Draft and Final Environmental Impact Reports on the proposed Plant stated repeatedly as one of the supposed environmental advantages of the Plant that the incinerator would eliminate the approximately 5,200 trash trucks which according to those reports enter and leave the Medical Area each year. Based on this estimate of the number of trash trucks entering and leaving the area each year, the Draft and Final Environmental Impact Reports claimed that even with the addition of more than 1,800 large 6,000 gallon oil trucks entering and leaving the area each year for the delivery of fuel oil, the proposed Plant would result in a net reduction in truck traffic in the area.

In our Comments on the Draft and Final Environmental Impact Reports, we questioned the accuracy of the estimates used in those Reports of the number of trash trucks supposedly entering and leaving the area which would be eliminated by the incinerator and the number of additional trucks which would enter and leave the area for the delivery of fuel oil for the Plant. We pointed out that those Reports substantially overestimated the number of trash trucks and substantially underestimated the number of additional oil trucks; and we pointed out that as a result the net reduction in truck traffic claimed in those Reports would not be achieved and the impact of the Plant in terms of additional truck traffic would be substantially greater than that indicated. You may wish to refer to our Comments of June 18, 1975, on the Draft Environmental Impact Report, at pp. IV-3-7, VII-6, VII-31-32, and VII-36; and my letter to you of November 3, 1975, regarding the Final Environmental Impact Report.

In any event, the Draft and Final Environmental Impact eports, proceeding on the assumption that the proposed Plant ith the incinerator would eliminate the trash trucks entering nd leaving the area, did not present a careful estimate of the umber of those trucks or undertake an analysis of their environ-ental impact beyond the emphasis on the environmental advantages laimed for the Plant by eliminating the trash trucks. Further-ore, the Draft and Environmental Impact Reports, proceeding on he further assumption that with the incinerator the Plant would roduce a net reduction in truck traffic in the area, did not resent an adequate analysis of the significant environmental mpact of the additional oil trucks which would enter and leave he area for the delivery of oil to the Plant, in terms of raffic congestion, noise and air pollution. See our Comments n the Draft Environmental Impact Report and my letter to you egarding the Final Environmental Impact Report referred to bove.

The Final Report on the removal of the incinerator from the lant now states at p.14 that since the incinerator is to be emoved from the Plant and the trash trucks in the area will herefore <u>not</u> be eliminated, "a more accurate estimate" of the umber of trash trucks was considered necessary. The Report then onfesses that as a result of actual surveys producing a more ccurate estimate, it now appears that approximately 1,820 - 600 rather than 5,200, trash trucks enter and leave the area ach year. The Report then proceeds to discuss the environmental pacts of the 1,820 - 2,600 trash trucks which now will continue enter and leave the area rather than be eliminated.

However, the central fact which the Report completely overlooks is that since these trash trucks will continue to enter and leave the area, the impact of the additional oil trucks for the Plant will now be entirely incremental. As indicated above, the Draft and Final Environmental Impact Reports, claiming the Plant would produce a net reduction in truck traffic, did not adequately analyze the impact of the additional oil trucks. And the Report on the removal of the incinerator deals only with the impact of the trash trucks which will remain.

Therefore, throughout the entire environmental review process
relating to the proposed Plant, there has been no analysis of the
overall environmental impact of the trash trucks and the addi-
tional oil trucks considered as a whole. A comprehensive analysis
of the overall impact of the operation of the Plant in terms of
truck traffic in the area is necessary. Instead of producing a
net reduction in truck traffic in the area, the operation of the
proposed Plant will now mean that several thousand additional
large 6,000 gallon oil trucks, each 55 feet long, will enter and
leave the area each year for the delivery of fuel oil to the
Plant, while 1,820 - 2,600 trash trucks continue to enter and
leave the area each year. The Draft and Final Environmental
Impact Reports stated that there are approximately 1,800 oil
trucks which now enter and leave the area each year for the deli- 8
very of fuel oil to the existing Harvard steam plant on Blackfan
Street, and that the operation of the new Plant will require
approximately 3,600 oil trucks to enter and leave the area each
year, an increase of 1,800 oil trucks. We have previously pointed
out that we believe the operation of the new Plant will require
approximately 6,600 oil trucks to enter and leave the area each
year, an increase of approximately 4,800 trucks assuming the
estimate of the oil trucks for the existing plant is accurate. A
total of 6,600 trucks a year means that on the average one oil
truck will enter and leave the area every hour and twenty minutes.
At no point throughout the entire review process has there been
any adequate discussion and analysis of the incremental impact of
these additional oil trucks, on the assumption that the trash
trucks will remain, in terms of traffic congestion, traffic
patterns, noise pollution or air pollution, or any discussion and
analysis of the combined impact of the oil trucks and trash
trucks on the area. Such an analysis requires, of course, that
there be an accurate estimate of the number of oil trucks which
will enter and leave the area each year for the operation of the
Plant, which in turn requires an accurate estimate of the annual
fuel oil consumption of the Plant.

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We also wish to call to your attention, in connection with the annual fuel oil consumption of the Plant, that the Final Environmental Impact Report on the Plant as supplemented claimed that the Plant would burn only approximately 27,000,000 gallons of fuel oil each year, and that this would be approximately 6,150,000 gallons less fuel oil each year than would be burned if the electric and steam requirements of the MASCO institutions were provided by alternate sources. In our Comments on the Final Environmental Impact Report we pointed out that we believe the Plant would burn substantially more than 27,000,000 gallons of fuel oil and possibly as much as 37,500,000 gallons of fuel oil each year. The original Application filed by Harvard University and MASCO with the Boston Redevelopment Authority for approval of the Plant as a Chapter 121A project stated that the Plant would burn approximately 10,500,000 gallons less fuel oil each year than would be burned if the MASCO institutions obtained their electricity and steam from alternate sources, although this figure had been stated as 6,150,000 gallons in both the Draft and Final Environmental Impact Reports. 9

The Second Amendment to the Application, recently filed by Harvard and MASCO with the Boston Redevelopment Authority in connection with the Third Amendment providing for the elimination of the incinerator, now states that the estimate of the claimed savings in fuel oil consumption has been reduced by Harvard and MASCO from 10,500,000 gallons to 2,000,000 gallons a year - a difference of 8,500,000 gallons.

This indicates again the necessity for an accurate and reliable estimate of the annual fuel oil consumption of the proposed Plant. An accurate estimate of fuel oil consumption is necessary not only to determine accurately the number of additional oil trucks which will be entering and leaving the area to deliver fuel oil to the Plant and their associated environmental impacts, but also to determine accurately the environmental impacts of the Plant in terms of air pollution.

In view of the foregoing we believe that the Report on the elimination of the incinerator is deficient and that it, like the Draft Environmental Impact Report and the Final Environmental Impact Report on the Medical Area Total Energy Plant, is inadequate for purposes of G.L. c.30, §62.

Yours truly,

John L. Sullivan

John L. Sullivan

Boston University

School of Law
765 Commonwealth Avenue
Boston, Massachusetts 02215

March 7, 1977

Ms. Evelyn F. Murphy, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02202

Re: Final Environmental Impact Report on the Removal of Incineration Service from the Medical Area Total Energy Plant (EOEA No. 01540)

Dear Secretary Murphy:

I am enclosing for your consideration a statement of "Substantial Changes from the EIR" adopted by the Brookline Selectmen's Ad Hoc Committee on The Harvard Energy Plant on March 7, 1977.

The statement draws attention to substantial changes that have been made in the project between the Secretary's approval of the Final Environmental Impact Report on January 23, 1976, and the filing of the Application for Air Quality Plans Approval on January 24, 1977. The Committee considers that these changes, together with the questions raised in The Air Quality Plans review and in the application of the December 21, 1976, Interpretive Ruling to the project, call for a thorough environmental impact review. The Committee considers, therefore, that the Secretary's present review should not be limited to the Removal of Incineration Service as has been done in The Final Environmental Impact Report captioned above.

The Committee's submissions in the Air Quality Plans review are being sent under separate cover for your information.

Sincerely,

Daniel G. Partan

Daniel G. Partan, Chairman
Brookline Selectmen's Committee

cc: Commissioner David Standley
Robert F. Walsh, Director,
Boston Redevelopment Authority
Dr. Anthony Cortese, Air & Hazardous Materials
Mr. John Desmond, Air & Hazardous Materials
Brookline Board of Selectmen
Brookline Conservation Commission
Director, Brookline Health Department

BROOKLINE SELECTMEN'S AD HOC COMMITTEE ON THE HARVARD ENERGY PLANT

March 7, 1977

Substantial Changes From The EIR

The height of the building from grade to the top of cooling tower array (covering over half the actual building top) has increased from 98 ft. (EIR Fig. 3.5.2) to 152 ft. (AQ Plans Fig. 3.8). This change not only results in a greatly increased visual impact but also substantially increases the chances of downwash from the stack in the immediate vicinity of the power plant building. Stack height to building ratio has gone from 3 to 2, thus falling well into a regime of concern (2.5). (10)

The noise design criteria have been changed from 50 dBA at the boundary of the building (EIR, pp 5-74, 5-75) to 60 dBA at the boundaries of the nearest private properties (AQ Plans pp 3-38 and Fig. 3-8). This substantial weakening of criteria, which will require a variance from the Boston Air Pollution Control Commission, would appear to have a substantial impact on the neighborhood. (11)

It would appear that these changes along with those to satisfy air pollution problems that have been brought up may make a thorough review of the environmental impact process prudent. (12)

The EIR does not deal with the impact of the Interpretive Ruling on MATEP, nor does it discuss in detail the past and present clear violations of primary standards for TSP and NOx which already exist in the area. The EIR should deal with the effect of the Interpretive Ruling on MATEP and should discuss alternative plans for MATEP which will minimize the problems for NOx and TSP. (13)

47 Hillside Street
Roxbury, Massachusetts 02120
March 17, 1977

cretary
Executive Office of Environmental Affairs
verett Saltonstall Building
0 Cambridge Street
ston, Massachusetts 02202

ATTENTION: Mepa Unit

E.O.E.A. File 01540

ar Secretary Murphy,

The Title of E.R.T. Document P-2858, Final Environmental Impact Report On The moval of Incineration Service From The Medical Area Total Energy Plant, herein referred as F.E.I.R.O.T.R.O.I.S.F.T.M.A.T.E.P., is as silly as the decision and procedure review bits and pieces of any project as large and with such ramifications as this e. It is with just such piece-meal tactics that Harvard and its affiliates have r years "nickeled and dimed" communities. Now it is the state and city agencies. e present document makes no more sense than if E.O.E.A. were to have reviewed each iler separately, each engine separately, each cooling tower separately.

This project and its impact on the surrounding non-attainment area which has a pulation already at high risk can only be adequately presented in a totally new vironmental impact report describing the present design of the plant and including comprehensive environmental review of that design and its impacts. One can only (14) nder at Harvard's repeated assertion that it does not need to do a new EIR. This is pposed to be a health-related project. It should, therefore, fit well within the st/benefit analysis to spend a little more money and a little more time in the interests safeguarding health and well being of people in the surrounding communities.

With regard to page 14 of F.E.I.R.O.T.O.I.S.F.M.A.T.E.P. we observe that when rvard/MASCO wished to impress the reviewers of the original Draft EIS, April 30, 1975, h its proposed incineration system, it was most convenient to have 5200 as the ber of trash trucks currently in use which would subsequently be eliminated. Now t the incineration system and its pneumatic collection system is to be eliminated, very convenient that a "more accurate estimate" has been procured reducing the ber of trash trucks in use to a mere 1800 to 2600.

On page 26 of F.E.I.R.O.T.O.I.S.F.M.A.T.E.P. there is the statement "...if 1500 s on Brookline Avenue were traveling at 20 miles per hour..." The fact is that (15) hing on Brookline Avenue moves at 20 miles per hour due to the traffic problems eady in existence, and now additionally compounded by construction. It was indeed ause of the traffic problem on Brookline Avenue that the Public Improvements Commission ied Harvard it's bid to take over Binney Street and close it for the duration of struction of the power plant and A.H.C. Despite the Harvard/MASCO traffic analysis, was reasoned that if Binney street were closed off, nothing on Brookline Avenue would e. Obviously, there are others who do not trust the Harvard/MASCO planners with ard to traffic analysis.

On page 38 of F.E.I.R.O.T.O.I.S.F.M.A.T.E.P. we are now told that small, local id waste disposal facilities are now "believed to be at cross purposes with current ional solid waste planning efforts," where not only future but present-day instal-

ations in Lawrence, Salem and elsewhere do indeed "emphasize large scale resource ecovery" of both energy and recyclable materials. If the Harvard/MASCO plant is now upposed to be "local, small scale, and less efficient" with regard to its incineration oncept (by E.R.T's own admission), a much stronger case can be made that the entire lant is based on outmoded design and is wasteful of resources. The economies of scale (16) d conservation of resources inherent in district steam, possibly with cogeneration, is alternative that should also be examined within this context. To allow the assertion at one function of the plant has now suddenly become wholly uneconomical and wasteful, erefore to be eliminated, mandates the same re-examination of the plant's other nctions as well.

Institutions other than Harvard have recognized environmental difficulties herent in proposed "total energy" facilities. Addressing themselves to these issues, ey have voluntarily made the moral decision to go another route, as in the case of tholic Medical Center in New Hampshire. Here, studies by Weather Dynamics, Inc. of wton showed that a 5% risk of plume impingment upon the surrounding area existed. In ew of this a decision was made to eliminate <u>any</u> such pollution, and an agreement was ached between the Public Service Corporation of New Hampshire, the Catholic Medical nter, and Megatherm Company of East Providence, Rhode Island. This joint venture l reliably supply all the Center's energy requirements without the otherwise adverse act of the first proposal. The area is nowhere as polluted as the location of the rvard/MASCO project, nor was the initial project anywhere near as large. Yet, a ssessment was made and another way was found to supply the Center's energy needs. implications for a reassessment of the proposed Harvard/MASCO project are even e clear.

Lastly, F.E.I.R.O.T.R.O.I.S.T.M.A.T.E.P. is incomplete. The other changes to project have not been included: electrostatic percipitators, substantiation of the l savings (now reduced to two million gallons per year), the problem with noise lution and the variance sought to bypass City regulations, and an "updated" traffic lysis for the entire area. Instead of dealing with these by means of an amendment he EIS, a questionable procedure to begin with, the applicants have been allowed ass these changes through channels other than the EIS process. The noise problem become a Request for a Variance to be granted by DEQE Commissioner Standley. The (17) ifications for the precipitators, still not "specified" however, are the subject n Environmental Assessment Form submitted jointly by the BRA for approval by still her department. E.R.T. is continuing an air pollution analysis to be submitted to with regard to what ammount is attributable to traffic and therefore leaving more in for the Harvard/MASCO project. And United Engineers has filed certain amendments e Ch 121-A application which will make rearrangement and changes in equipment and m all perfectly legal.

Clearly, there is something amiss here. The decision to allow for this procedural entation of changes to the project is not in the best interests of the project, f the environment which your agency is charged to protect. Neither is it in the interest of your agency. And this precedent is certainly not in the interest of gthening and fine-tuning M.E.P.A. and interpretative rulings affecting its scope readth. If your agency allows F.E.I.R.O.T.R.O.I.S.F.T.M.A.T.E.P. to represent what deed <u>is not</u>, you will have considerably weakened your hand in other such projects ll have seriously jeopardized the future and the effectiveness of the Office of nmental Affairs.

Meanwhile, Harvard, instead of planning coherently for energy efficiency and the nment, for controlled growth and exemplary medical research and health care ry, will instead have been allowed to sieze upon whatever means in their ...

ustify and expedite this monstrous venture, in violation of the principles of man nature, and even of technology itself. It can only be but to the detriment of yone—most of all to Harvard itself.

Respectfully,

Michael Lambert

Michael Lambert, Charlotte Ploss
R.U.S.H.

Response to the Letter from the Secretary of Environmental Affairs Dated March 24, 1977

1. The analysis of alternative solid waste management programs has been expanded and is presented in Section 4.0 Removal of Incineration Service. Alternatives analyzed are listed on p. 4-6. The selected program which offers the best opportunity to mitigate adverse consequences is summarized on p. 4-1 and described in more detail on p. 4-18. Appendices D and E demonstrate the commitment to the selected program.

2. Please refer to the response to Comment 1.

3. Programs for waste volume reduction are discussed beginning on p. 4-22 of this report. MASCO can reduce volume by about 20% on a short term basis by the use of more efficient compaction equipment. MASCO will prepare a study and make recommendations to the member institutions concerning cost-effective source separation and recovery programs.

4. A prime factor in the development of the business plan for control of solid waste removal by MASCO will be improvements in aesthetic, safety, sanitary and parking interaction characteristics. This is discussed on p. 4-18. An example of the effort already expended to plan for improvements appears in Appendix E.

5. Truck trips for various solid waste removal alternatives are shown on Table 4-2. These are incorporated into the analysis of the total fuel delivery and trash truck trips shown on Table 6-1 (p. 6-12).

6. Please refer to the response to Comment 1.

7. The report to which this response is attached provides supplemental information for a thorough analysis of the proposed changes.

<u>Response to the Letter from Boston Edison</u>
<u>date March 11, 1977</u>

8. Section 6 of this report provides an analysis of the trucks resulting from trash removal and fuel delivery.

9. Section 8 of this report provides the results of an accurate and reliable estimate of the annual fuel consumption.

Response to the Letter from the
Brookline Selectmen's Committee
dated March 7, 1977

10. Section 9 of this report discusses the effect of the cooling tower height increase. Appendix I presents the results of an analysis from Dr. James Halitsky.

11. Section 5 of this report discusses the need for the proposed noise deviation and its effect on the neighborhood.

12. Please refer to the response to Comment 7.

13. MATEP will demonstrate compliance with the Interpretive Ruling. This will be done with the Department of Environmental Quality Engineering as part of the plans approval process.

<u>Response to the Letter from RUSH
dated March 17, 1977</u>

14. Please refer to the response to Comment 7.

15. The analysis of truck traffic impacts is now done on the basis of traffic traveling at 10 miles per hour. This analysis is discussed on pages 4-17 and 6-4.

16. The primary reason for the removal of the incineration service was to remove a potential new source of particulate emissions. Removal of solid waste by incineration is not a critical aspect of the project and it was determined that the alternative means of disposal are environmentally preferable in this case. A determination has been made that the economic benefits previously hoped for from the incineration concept could not be completely realized. Similarly, a determination has been made that the critical production of utility services by MATEP is still the most economical method to meet the insitutions' needs.

17. Please refer to the response to Comment 7.

APPENDIX A

Trash Collection Procedures of Member Institutions

APPENDIX A

Information on current trash collection procedures of MASCO member institutions and on-site recycling was obtained through a telephone survey. Calls were made to executive housekeeping personnel on April 8 and 11, 1977. A summary of information obtained for each institution is given below.

New England Deaconess (Mr. Peter Dalton)

Burnable wastes are compacted in a 40-yard compactor, picked up six times per week. An 8-yard open box used (primarily) for animal droppings is picked up twice a week. NEDH's contract expired recently and it is using its previous contractor on a short-term (monthly invoice) basis. Construction wastes are deposited in a 25-yard open box, picked up when full on an on-call basis averaging once every one and one-half to two weeks. Linens, towels, food containers, etc., are all reusable. Recycling is limited to collection and selling of computer and office paper.

Beth Israel (Mr. William Murphy)

The hospital has one compactor, emptied three to four days per week on an on-call basis. Its contract is renewed annually. A dumpster has been recently installed for cartons and wood. Linens, towels, etc., are reusable. Food containers used by patients are reusable. Food containers used by staff (in cafeteria) are currently disposable, but a switch to reusables is contemplated. There is no recycling program.

Childrens Hospital (Mr. Tinnin)

It has three compactors: two 30-yard units (in Research Department) and one 40-yard. Also, five 5-yard open containers, where trash is stored in heavy-gage plastic bags. The compactor wastes are emptied on an on-call basis (averaging about three times per month), with the 40-yard one being empited four times per week. Its contract is renewed annually. Linen and food containers are reusable. There is no recycling at present, although Mr. Tinnin said that possibilities were being explored.

Massachusetts College of Pharmacy (Mr. Charles Roberto)

It has a single 18-yard compactor which takes the individual (small) plastic bags of wastes and compacts them into one large bag. Cardboard boxes are broken up. Bottles from experiments are handled separately. It also has a very small incinerator for minor paper wastes. No recycling is done. There are no patients. Experimental animals are taken to Harvard.

Sidney Farber Cancer Institute (Ms. Boughton/Mr. M. Lederman)

There are three buildings in the Sidney Farber complex. Building No. 1 has a 20-yard dumpster/compactor emptied on Monday, Wednesday and Friday of each week, more often if necessary.* Building No. 2 has a 30-yard dumpster/compactor which is completely emptied on an on-call basis, averaging twice a week. Building No. 3 has three 10-yard (closed) dumpsters which are emptied every day. Needles and syringes are picked up by a private incinerator company. Cafeteria items are disposable, but not patient food containers or linens/towels. The Institute has only 28 beds, plus an out-patient department.

Joslin Diabetics (Mr. Tom Jordan)

All wastes are transported in carts to New England Deasoness (across the street), which is then added to NEDH wastes and disposed of in the manner described above. However, Mr. Jorden indicated that their own waste burden was rapidly becoming too much for NEDH to handle and that he was exploring alternatives for an in-house disposal plan. All burnables are currently placed in heavy duty plastic bags. Needles and syringes are handled in a special manner. Joslin has no beds, only an in-patient ambulatory unit. Both patients and staff eat in centralized facilities, which utilize disposable food service containers (plates, cups, etc.) and permanent flatware. Recycling is limited to collecting and selling computer cards.

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*Tipped and emptied.

Peter Bent Brigham Hospital (Mr. Gary Camponelli)

PBBH has a self-contained 40-yard compactor for general wastes which is emptied three times a week (Monday, Wednesday, and Friday) and more often if necessary. Internally, waste is transported (by hand) in 4-yard plastic bag lined carts via service elevators. Mr. Camponelli indicated that he was exploring the possibility of a mechanized cart system. Needles, syringes and laboratory wastes are handled separately, as well as certain large items (old furniture, radiators, metal or wood packaging wastes, etc.) for which they have a 10-yard dumpster emptied approximately once a week, on the average. Its contract is renewed annually. No recycling is currently being done, and office paper wastes are shredded on site. Mr. Camponelli mentioned that they had many problems with their former compactor (the breakaway kind), all of which have been eliminated by their recently acquired self-contained compactor. He also stated, however, that surveillance was needed to prevent people from depositing objects into the unit which could damage it.

Harvard Medical School (Mr. Al Powers)

Harvard has a 40-yard dumpster/compactor which serves the main quadrangle area and numerous small open dumpsters for most individual buildings outside this area. These containers are emptied three times weekly and their contract is renewable annually. Harvard has a separate container and contractor for special items which cannot be fed into the compactor (old furniture, metal and wood packaging, etc.) and which is hauled away on an on-call basis. Hazardous and pathological wastes are handled separately and incinerated. There is no recycling of any kind and, at present, no plans for such a program.

APPENDIX B

PROCEDURE USED TO ESTIMATE CURRENT NUMBER OF TRASH TRUCK TRIPS

APPENDIX B

PROCEDURE USED TO ESTIMATE CURRENT NUMBER OF TRASH TRUCK TRIPS

Section 4 of this report presented a range of 45 to 50 trash truck trips per week. This appendix shows how these numbers were obtained.

For reach roll off container listed in Table B-1, an average number of pickups per week was obtained from housekeeping personnel or the waste collection contractor. For most of the 9 roll-off containers now in use, the collection contractor can remove a filled container on one leg of his trip and bring an empty back on the return leg. In the case of Beth Israel Hospital the contractor indicated using another trip to bring an empty container back. Thus 3.5 trips are added to the 33 pickup operations to obtain 36.5 truck trips per week to service the roll-off containers.

TABLE B-1

Hospital	Roll-Off Container Size (cy yds)	Average Number of Pickups per Week
Deaconess	40	6
Beth Israel	35	3.5
Jimmy Fund	10	6
Dana Building	30	3
Brigham	30	6
Childrens	40	3.5
Childrens	30	1
Boston Hosp. for Women	30	3
H. Med. Schools	40	1
Total Pickups		33
Beth Israel return trips		3.5
Total Truck trips to service roll-off containers		36.5

Collection of loose waste stored in dumpsters and bags is accomplished by compactor trucks. While the number of loose waste pickups (63) represents approximately twice the number roll-off container pickups

fewer truck trips are required. This is because much less trash is at each pickup point and one truck can therefore make multiple pickups during one trip.* Two contractors currently make such pickups in the medical area; one makes daily pickups (6 days) and the other makes pickups twice a week. Thus, 6 + 2 = 8 trips week are now used to pickup loose waste. The number of weekly trash truck trips is therefor the sum of trips to service roll-off containers (36.5) and loose waste containers (8) for a total of approximately 45 truck trips.

The Redstone Building is currently in the final stages of renovation. When it becomes operational it is expected to require 5 to 6 pickups per week and may use a different contractor than those currently making loose waste pickups. Therefore another 5 truck trips may be required in the near future, for a total for 50 truck trips per week.

*A compactor truck can typically hold 5 tons of waste. The loose waste collected each day from the medical area is approximately 3.5 tons.

APPENDIX C

REDESIGNED INCINERATION AND PNEUMATIC SOLID WASTE CONVEYANCE SYSTEMS

APPENDIX C

Introduction

This appendix describes the redesigned incineration and pneumatic conveyancy system which is significantly different than the design originally presented in Final Environmental Impact Report (September 29, 1975).

Description of the Central Collection System

The central collection system would be designed to convey general hospital wastes to the Total Energy Plant. It would consist of a network of transfer piping located underground in utility tunnels for conveying the solid waste from the institutions to the central plant where it would be separated from the conveying air stream and metered to the incinerators.

Each institution would be provided with a floor mounted loading station comprised of a loading hopper, air inlet valve, and material discharge valve.

Once deposited in the hopper the refuse would be allowed to accumulate above a discharge valve prior to being released into the conveying air stream.

The system would be automatically controlled from a central panel. Initiation of a collection cycle would occur on a scheduled basis every 15 minutes. Once a cycle is initiated, the exhauster would be started, the air inlet valve would be opened, and air flow would be established in the conveying pipe. The discharge valve would then open allowing the refuse to fall into the negatively pressurized 20 inch conveying pipe. This cycle would be repeated in sequence until all loading stations have been emptied.

From each collection point, the waste would be conveyed in a high velocity air stream through the pipe to cyclones located at the central plant. The wastes would be separated from the air stream in each cyclone which would be equpped with a slide gate airlock. Between collection cycles, the cyclones would automatically discharge through the slide

gates into shredders for size reduction. The waste would then be conveyed to the surge storage hopper and material would be metered to the incinerators.

From the cyclones the conveying air would be filtered and discharged to the atmosphere through sound attenuators.

Description of the Incineration System

Three oil fired controlled air incinerators would be provided, each capable of burning 2,500 pounds per hour of wastes comprised of hospital trash and garbage. Each incinerator would be complete with a ram charging system to facilitate loading of the waste materials. Waste from the storage hopper would be conveyed to each incinerator ram feed hopper. Once loaded in the hopper, the operating sequence and burning cycle would be entirely automated.

Following a short preheating period, the lower chamber or ignition chamber would be charged with the waste material. Exhaust gases and unburned particles would be directed into the second combustion chamber which would be provided with a second burner to complete the combustion process on all burnable waste and exhaust products. Sulfur dioxide, nitrogen oxides and particulates would be formed during the combustion of the wastes. While sulfur dioxide emissions cannot readily be controlled, the two stage combusition is designed to reduce formation of nitrogen oxides and particulates.

In this current design of the incineration system, separate heat recovery boilers would be used, and exhaust gases would then go directly to the stack rather than into the package steam boilers.

The sterile residue resulting from the process would be removed automatically from each incinerator, deposited in a quenching hopper, and conveyed to storage in a small portable container located below the incinerator room for daily removal from the Total Energy Plant.

Risk Aspects of Maintenance and Operation of Incineration and Conveying System

Incinerators have a history of unreliable operation. Any installation requires a backup or standby in the event of equipment failure.

There are safety hazards present during the daily operation. Medicines, empty alcohol containers, or any trash saturated with flammable liquids could accidently enter the system due to human error. Large amounts of these materials could go undetected due to the automated nature of the conveying and feed system. These materials could pose a potential risk to the incinerator, its operators, and the Total Energy Plant.

Other aspects of maintaining and operating an automated conveyance system have been presented in Section 5.6 of this report.

Air Contaminant Emissions from Incineration

The incineration of wastes at the Total Energy Plant would result primarily in emissions of sulfur dioxide, nitrogen oxides and particulates. Quantities of SO_2 are primarily a function of sulfur contained in the wastes. NO_2 and particulates are more dependent upon the type of incinerator and method of operation. Organic acids may also be created when certain plastics are burned. This is dependent upon the characteristics of the wastes to be incinerated.

Air contaminant emissions from a multiple chamber and controlled in industrial/commercial incinerator are listed in Table C-1. It would be desirable to eliminate these emissions since the greater Boston area is considered to be a non-attainment area for particulates by the Department of Environmental Quality Engineering and organic acids may be released due to the presence of plastics.

Changes in Waste Collection

While the central incineration system would be able to dispose of all general hospital wastes, the reduction is dependent upon the quality of wastes which can be safely passed through the pneumatic piping system.

The proportion of waste which is pneumatic system can handle is related to the particle size distribution in the waste and the design of the piping system. An estimate by UE&C is that up to 25 percent of the general hospital wastes would be nonconveyable, based upon a 20 inch diameter pipe system design. Thus, alternate approaches for the collection and disposal of this nonconveyable trash would be required. One

TABLE C-1

EMISSION RATES AND EMISSIONS BASED ON CURRENT DESIGNS OF INCINERATOR SYSTEM

Controlled Air Industrial/Commerical Incinerator	lb/ton of Refuse	lb/hour Based on Burning 39 Tons During a 17 Hour period[a]	lb/year Based on Burning 12,325 tons[a]
SO_2	1.5	3.4	18,488
NO_2	10.0	22.9	123,250
Particulates			
with secondary combustion and no additional collection equipment	1.4	3.2	17,255
with a cyclone having collection efficiency of 42%	0.81	1.9	9,983
with a scrubber having a collection efficiency of 80%	0.28	0.6	3,451
with an electrostatic precipitator having a collection efficiency of 86%	0.20	0.5	2,465
Carbon Monoxide	negligible	negligible	negligible

Source: Supplement No. 5 for Compilation of Air Pollutant Emissions Factor-Second Edition, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, December 1975.

[a]Solid waste tonnages are based on estimates for the year 1980. It has been assumed that all solid waste generated would be burned. However, up to 25% of the wastes might still have to be disposed of in other ways since they may not be able to be conveyed to the incinerator. Thus, all quantities of emissions might be reduced by 25%.

Note: Emissions of other contaminants such as organic acids associated with incineration have not been included since they are dependent upon types and quantities of materials burned.

approach would be to employ either hand carts or light duty shuttle vehicles to collect this trash and bring it to the Total Energy Plant for incineration. Another approach would be to continue, with less frequent pickups, essentially the existing trash collection and disposal system for the nonconveyable wastes.

APPENDIX D

MASCO Board Vote and Associated Letters

MEDICAL AREA SERVICE CORPORATION

Certificate of Vote

I, Hugh R. Jones, Jr., Clerk of Medical Area Service Corporation, a Massachusetts charitable corporation incorporated under the laws of Section 180 of the Massachusetts General Laws hereby certify that the following vote was duly adopted by the Board of Directors of Medical Area Service Corporation at a meeting of said Board duly called and held in Boston, Massachusetts on April 13, 1977, at which a quorum was present and voting throughout.

VOTED: That the Executive Vice President be and hereby is instructed to develop a proposal for the efficient and environmentally improved handling of its members solid waste disposal. Such a proposal should consider, without being limited to, the separation of re-cyclable materials, standardization of compaction equipment, re-examination of existing collection locations, establishment of uniform maintenance practices, and increasing collection efficiency through the use of a single disposal contractor.

I futher certify that the foregoing vote has not been modified or rescinded in any respect and is still in full force and effect.

IN WITNESS WHEREOF, I have executed this Certificate of Vote at Boston, Massachusetts this 25th day of April, 1977, as the duly elected Clerk of Medical Area Service Corporation hereunto duly authorized.

Hugh R. Jones, Jr.

Hugh R. Jones, Jr.
Clerk, Medical Area Service Corporation

L T. RABKIN, M.D.
neral Director

Beth Israel Hospital

330 BROOKLINE AVENUE · BOSTON, MASSACHUSETTS 02215

April 28, 1977

Mr. Richard C. Walsh
Director
Boston Redevelopment Authority
City Hall - Room 937
Boston, MA 02201

Dear Mr. Walsh:

The Beth Israel Hospital would like to be on record as supporting the vote taken at the April 13, 1977 Board of Directors meeting of the Medical Area Service Corporation to plan for improved methods of solid waste disposal in the Longwood Medical Area.

Sincerely,

David Dolins
Associate Director

DD:jb
CC: Commissioner David Standley
Department of Environmental
Quality Engineering

BCC: Philip Jenks

Affiliated Hospitals Center, Inc.
A union of the
Boston Hospital for Women
Peter Bent Brigham Hospital
Robert B. Brigham Hospital
Teaching Hospitals of Harvard Medical School

)ffice of the
ve Vice President
732- 5511

April 27, 1977

Commissioner David Standley
Department of Environmental
Quality Engineering
100 Cambridge Street
Boston, MA 02202

Dear Commissioner Standley:

The Affiliated Hospitals Center, Inc. (Boston Hospital for Women, Peter Bent Brigham Hospital, Robert B. Brigham Hospital) would like to be placed on record as strongly supporting MASCO's vote to plan improved methods of solid waste disposal in the medical area.

Sincerely,

Richard D. Wittrup

Richard D. Wittrup
Executive Vice President

RDW:pfb

cc: Mr. Philip Jenks

The Children's Hospital Medical Center

300 Longwood Avenue, Boston, Massachusetts 02115, Telephone: (617) 734-6000

April 28, 1977

Commissioner David Standley
Department of Environmental Quality
Engineering
100 Cambridge Street
Boston, MA 02202

Dear Commissioner Standley:

It is my understanding that the Medical Area Service Corporation has declared its interest in providing contractual services within the medical area for the collection and disposal of solid waste. Although at present our institution, through a Waste Disposal Company, collects and disposes its solid waste, we do support MASCO's efforts to provide joint service within the medical area.

Sincerely,

Paul L. Broughton

Paul L. Broughton
Director of Clinical
and Administrative Services

PLB/mch

cc: MASCO
Mr. Richard C. Walsh
Director, Boston Redevelopment
Authority
City Hall, Room 937
Boston, MA 02201

JOSLIN DIABETES FOUNDATION, INC.
ONE JOSLIN PLACE, BOSTON, MASSACHUSETTS 02215 (617) 732-2400

April 27, 1977

Mr. Richard C. Walsh
Director
Boston Redevelopment Authority
City Hall - Room 937
One City Hall Square
Boston, MA 02201

Dear Mr. Walsh:

In keeping with our support of shared services through the Medical Area Service Corporation, the Joslin Diabetes Foundation supports the proposal to plan for improved methods of solid waste disposal for the institutions in the Longwood Medical Area.

Cordially,

JOSLIN DIABETES FOUNDATION

W. D. Barry

William D. Barry
Executive Director

WDB/h

cc: Mr. Phillip A. Jenks
Director of Operations
Medical Area Service Corporation

NEW ENGLAND DEACONESS HOSPITAL

ONE EIGHTY-FIVE PILGRIM ROAD, BOSTON, MASSACHUSETTS 02215
TELEPHONE: (617) 734-7000

R. O. LOWRY
Executive Vice President

RICHARD E. LEE
Director

April 27, 1977

Mr. Richard C. Walsh, Director of
The Boston Redevelopment Authority
City Hall, Room 937
Boston, Massachusetts 02201

Dear Mr. Walsh:

The New England Deaconess Hospital would like to be on record as supporting the vote taken at the April 13, 1977, Board of Directors meeting of the Medical Area Service Corporation to plan for improved methods of solid waste disposal in the Longwood medical area.

Very truly yours,

Richard E. Lee

Richard E. Lee

REL:GEG

cc: Commissioner David Standley
Department of Environmental Quality Engineering
100 Cambridge Street
Boston, Massachusetts 02202

MASSACHUSETTS
COLLEGE
OF PHARMACY

Vice President for Finance and Budget

April 28, 1977

Commissioner David Standley
Department of Environmental
Quality Engineering
100 Cambridge Street
Boston, Massachusetts 02202

Dear Commissioner Standley:

As a member institution of MASCO, the College endorses the concept of MASCO's proposal for the efficient and environmentally improved handling of solid waste disposal. It supports the idea that the proposal should consider, without being limited to, the separation of recyclable materials, standardization of compacting equipment, reexamination of existing collection locations, establishment of uniform maintenance practices, and increasing collection efficiency through the use of a single disposal contractor.

Sincerely,

M.J. Stoklosa

M.J. Stoklosa, Sc.D.
Vice President for Finance and Budget

MJS/sz
cc: Mr. Richard C. Walsh

179 Longwood Avenue
Boston, Massachusetts 02115
Phone (617) 734-6700

SIDNEY FARBER CANCER INSTITUTE
CHARLES A. DANA CANCER CENTER
44 BINNEY STREET, BOSTON, MASSACHUSETTS 02115

THE JIMMY FUND

S. GOLDBERG
ADMINISTRATOR
3450

April 28, 1977

Commissioner David Standley
Department of Environmental
Quality Engineering
100 Cambridge Street
Boston, MA. 02202

Dear Commissioner Standley:

The Sidney Farber Cancer Institute wholeheartedly supports the Resolution passed by the Board of MASCO to explore more efficient and effective handling of solid waste disposal. We understand that this study will include a review of the issues relating to recycling, standardization and maintenance of equipment, collection locations, a uniform collection contract.

We further understand that the cost implications of our entering into a shared solid waste disposal system will be provided by this study. Should the cost implications of a uniform system under MASCO's auspices be advantageous, the Institute would most certainly support the implementation of such a plan.

Yours truly,

Gerald S. Goldberg

Gerald S. Goldberg
Administrator

cc: Richard Walsh
Director, BRA

bcc: Kip McClelland
MASCO

GSG:ejs

HARVARD UNIVERSITY
DEPARTMENT OF BUILDINGS AND GROUNDS
25 SHATTUCK STREET, BOSTON, MASSACHUSETTS 02115

734-3300

April 28, 1977

Commissioner David Standly
Department of Environmental Quality Engineering
100 Cambridge Street
Boston, MA 02202

Dear Commissioner Standly:

I am informed that the Medical Area Service Corporation at the request of its Board of Directors is undertaking a comprehensive study for a centralized rubbish collection plan for all the member institutions.

The Harvard University Department of Buildings and Grounds is responsible for the disposal of solid waste material from the Medical School, Dental School and School of Public Health in the Harvard Medical Area. This is presently being accomplished through contractor pick-ups within the area.

To the extent that a centralized rubbish collection plan for all of the member institutions can conceivably produce economic and environmental advantages, the Department of Buildings and Grounds supports this study. Whatever final action Harvard will take will be dependent on the results of this study and other considerations.

Yours very truly,

Alan J. Powers
Superintendent of Buildings and Grounds
Harvard Medical Area

AJP:HBT

cc: Mr. L. Joyce
cc: Mr. L. Dunn
cc: Mr. H. Meadow
cc: Mr. K. McClelland

APPENDIX E

Summary of BTA Recommended Improvements to Solid Waste System

APPENDIX E

Benjamin Thompson & Associates, Inc. have prepared a detailed business plan which will be implemented by MASCO to improve the existing solid waste disposal system in the area. For each of the 27 identified disposal points a detailed analysis of location, equipment and aesthetics has been completed. One example has been provided here for information. The complete report is voluminous and is not included in this document. It is available for review upon request. The results of this program will be 39% reduction in the number of truck trips using centralized control, a 20% reduction in volume using better compacting equipment, and numerous aesthetic and safety improvements.

BENJAMIN THOMPSON & ASSOCIATES, INC
ONE STORY STREET. CAMBRIDGE. MASSACHUSETTS 02138 • TELEPHONE 876-4300

April 8, 1977

Board of Directors
Medical Area Service Corporation
59 Binney Street
Boston, Mass. 02115

Re: Solid Waste Disposal for the Medical Area

Gentlemen:

In our capacity as consultants for the Total Energy Plant we have undertaken a study of solid waste disposal provisions in the Medical Area:

Based upon our preliminary findings we wish to make the following recommendations to the Board:

1. That MASCO exercise, as part of its overall responsibility solid waste disposal planning in the Medical Area and,

2. That a business plan based upon such planning be developed that will be offered to the member institutions.

Such a business plan would include provisions to standardize compaction equipment, upgrade existing collection points, establish uniform maintenance practices, and increase collection efficiency through use of a single disposal contractor.

Adoption of a policy of uniform solid waste disposal for the Medical Area would result in significant benefits:

- Reduced volume of waste
- Reduced truck traffic
- Reduced noise
- Reduced interference with parking spaces
- Improved appearance
- Improved safety and sanitary conditions

Our analysis indicates that such a plan of action - incorporating the above environmental benefits - could be implemented at an equivalent cost to that presently being paid by member institutions for waste disposal.

Very truly yours,

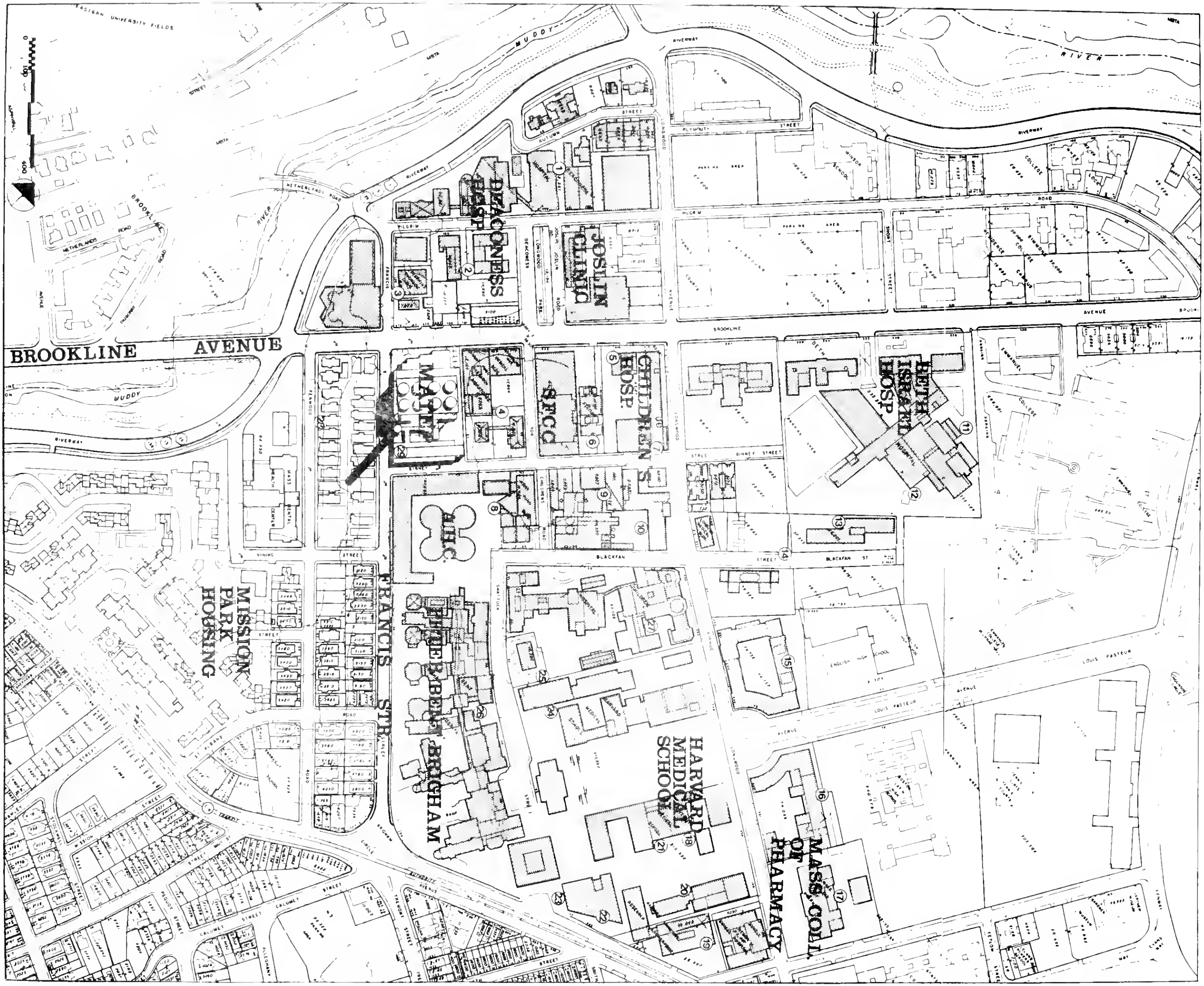
BENJAMIN THOMPSON & ASSOCIATES, INC.

Bruno D'Agostino

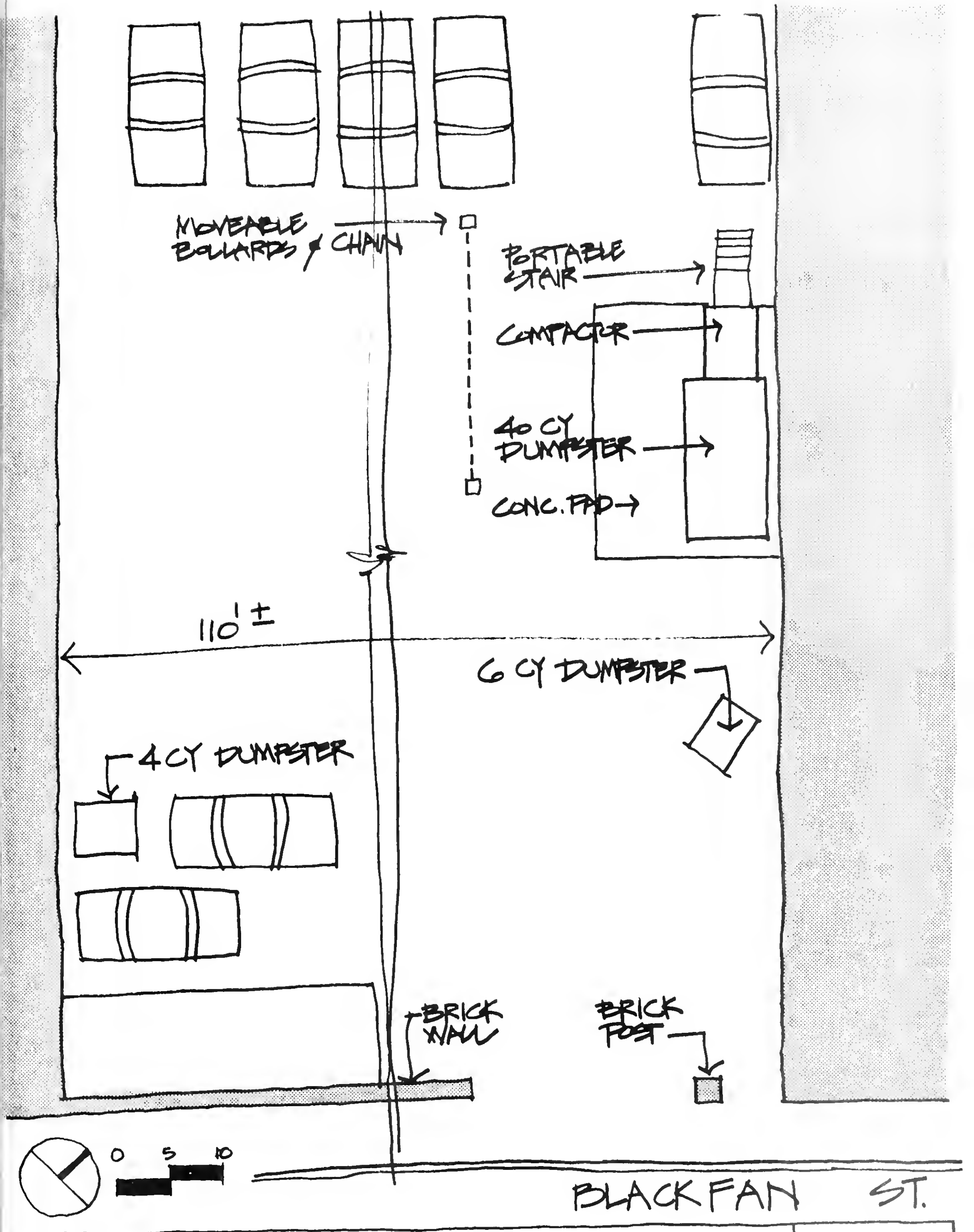
Bruno D'Agostino
lt

K COUNT SUMMARY

EXISTING								PROPOSED	
CONTRACTOR A		CONTRACTOR B		CONTRACTOR C		CONTRACTOR D			
ROLL OFF	GARBAGE	ROLL OFF	GARBAGE	ROLL OFF	GARBAGE	ROLL OFF	GARBAGE	ROLL OFF	GARBAGE
6								5	
	2								1
	3								3
							6		1
				1					3
3								2	
			3						2
	0								3
	1								1
1	6							1	
		4						4	
			0						2
	2								1/2
	1								1
	6								2
3								2	
	2								1
1								1	
	6								1
	6								1
	6								1
	6								1
	6								1
	6								1
	1								1
6								5	
4								4	
24	60	4	3	1			6	24	28



EXISTING AND FUTURE SOLID WASTE COLLECTION POINTS



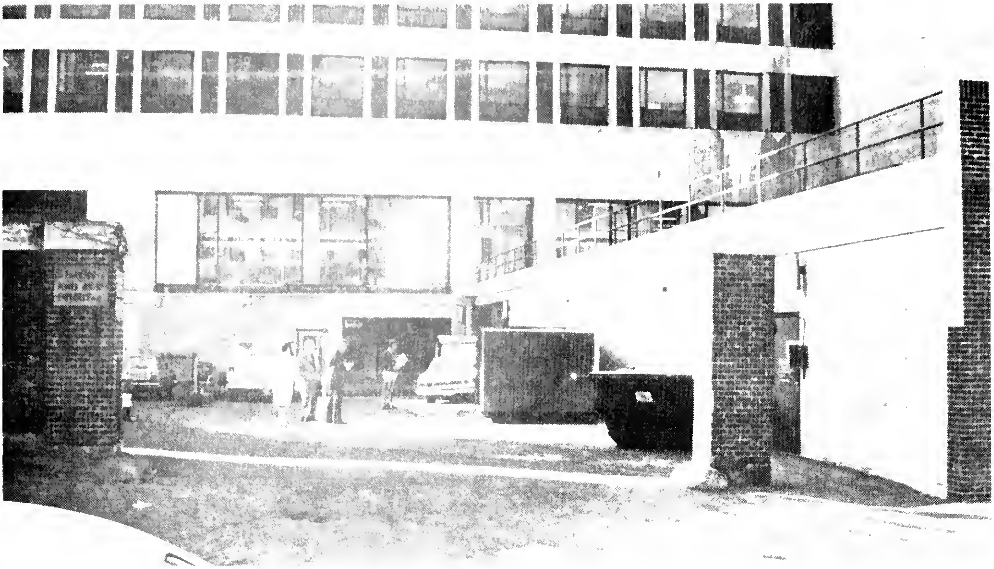
EXISTING / CHMC ENDERS BLDG

10

EQUIPMENT SURVEY

SITE LOCATION NUMBER 10

EXISTING	PROPOSED
1 c.y. compactor w/30 c.y. container	- 2 c.y. compactor w/40 c.y. container
Inefficient compaction	- Platform w/wind screen
Oil leakage	- 6" pad and drain
Needs 6" pad and drain	- Enclosure for wire and hoses
Needs dumping platform	- Study possibility of more effective location
No key lock	- Study possibility of consolidation to eliminate the 6 c.y. and 4 c.y. containers
6 c.y. rear load container OK	- Possible to pick up 2 parking spaces w/elimination of 2 containers
4 c.y. rear load container OK	
1 pickup/week for compactor	- 1 pickup/week
6 pickups/week for containers	



10.A TRUCK ACCESS FROM BLACKFAN ST.

10.B VIEW OF DUMPSTER BEHIND EXISTING PLANT

ENDERS BUILDING

10.C VIEW TOWARD BLACKFAN ST.

ENDERS BUILDING

APPENDIX F

Community Noise Response

Reprinted from Noise Control, Vol. 1, No. 1, 63-71, January, 1955
Printed in U. S. A.

A Community's Reaction to Noise: Can It Be Forecast?

K. N. STEVENS, W. A. ROSENBLITH, AND R. H. BOLT

BOLT BERANEK AND NEWMAN INC.

The composite noise rating *may make it possible to assess the community's reaction even before the noise is turned on.*

NOBODY--least of all the authors of this paper—will try to tell you how quiet your neighborhood should be. In a country like ours, these matters are not decided by fiat. We do it another way—we find out how much quiet, or lack of noise, people like. This job calls for sensible yardsticks, yardsticks that will help us to assess a noise and to rate a community's reaction to noise.

How did we arrive at the scheme that we are about to outline? We studied a number of actual communities. In each one we measured all the things about the noise that seemed to matter. We looked at the way the people had reacted to the noise: mild squawks, vigorous complaints, or what. Then we tried to find a relation between the noise in all its aspects and the observed reaction of the community. We summarized these findings in a set of charts and tables and applied the scheme to forecast community reactions in some new situations. By and large the method worked. From this we are hopeful that it may help to set design goals for the noise control engineer who is given the job of bringing "peace and quiet" to a neighborhood.

The basis of such a scheme is the assumption that people will continue to behave in the future as they have in the past. There will be small drifts, but on the whole the social group will be stable in its responses to noise. Drastic events may upset this stability, but our assumption is probably a reasonable one, so long as we keep alert to signs of possible change. A noise that was once taboo may in time become acceptable. The opposite may also happen. A particular noise may at some time be linked with a disastrous event; thereafter it becomes a warning signal, and the community becomes much less tolerant of it.

What is noise? The only generally accepted definition of noise specifies it as sound unwanted by someone in some context. Hence, we should not be surprised that the same amount of sound energy may be considered noise in a block of hospital buildings, while it may pass unnoticed in the neighborhood of supermarkets and a drive-in theater.

If we were to list the factors that make for pleasant residential living, we would encounter insistence on cleanliness, absence of pollution and excessive traffic, and quiet. Though people differ in their tastes and in the emphasis they put on these requirements, we would not go too far wrong if we assumed that the majority would like to be rid of sources of noise that are not in their control. These opinions or value judgments may be expressed more forcefully by suburbanites than by tenement dwellers, but the desire for "peace and quiet" is accepted as an ideal by most Americans.

THE AUTHORS

K. N. Stevens is Assistant Professor of Electrical Communications at the Massachusetts Institute of Technology. He is active in the fields of noise control engineering and speech communication research.

W. A. Rosenblith, Associate Professor of Communications Biophysics at the Massachusetts Institute of Technology, has been named chairman of an exploratory subcommittee which the American Standards Association has set up to investigate criteria for noise control in the realm of community living.

R. H. Bolt is Professor of Acoustics and Director of the Acoustics Laboratory at the Massachusetts Institute of Technology, and Chairman of the Board of Directors of the consulting firm of Bolt Beranek and Newman Inc. He is also serving as chairman of the Armed Services-National Research Council Committee on Hearing and Bio-acoustics.

Stimuli and Responses

That people react differently to different sounds is a truism. We can relieve some of its obviousness by adding that people may react differently to identical sounds and may behave similarly in response to sounds that are physically quite different.

How can we best understand man's behavior in response to sounds? That depends to some extent on what aspects of man's behavior we are interested in. We have no reason to assume that a man will react similarly to a word, a cry, a whistle, the whoosh of a jet plane, the bark of a dog, or the dripping of a water faucet. Outside of the laboratory we may well ask ourselves if it is indeed

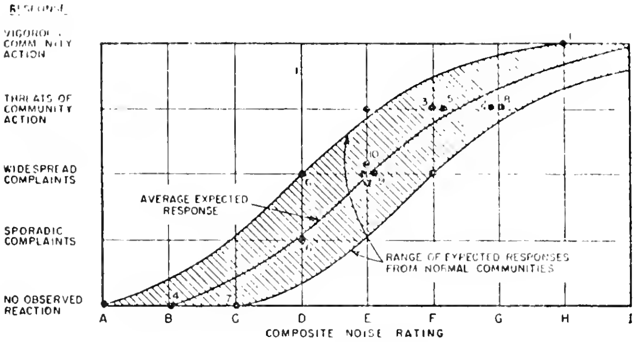


Fig. 1. The wide curve shows the range of responses that can be expected from communities exposed to noises of increasing severity. The center curve is the average response. Community response is assessed along the ordinate. Each point represents a case history of neighborhood reaction to noise, the numbered points refer to the case histories in Table III.

the stimulus that determines a person's or a group's response.

What do we mean by "the stimulus" in everyday situations? Is it enough to state the sound pressure levels in various octaves, or must we also add that this sound is produced by a railroad train that has been passing a dozen times a day for the past twenty years? The dictionary tells us that whatever affects us, excites us, or goads us into action is a stimulus, but such a definition is of limited value to us. The more technical definition used by experimental psychologists tells us that stimuli are events in man's environment. More precisely, the experimenter generally designates as stimuli a particular category of events in the environment that he has under his control. Under these circumstances an acoustic stimulus becomes a certain amount of vibratory energy presented to an observer at selected time intervals.

Next we need to consider what we are going to call a "response." A man, or for that matter a guinea pig, behaves in many ways: he breathes, his heart beats, he perspires, he looks about, he moves, he talks, and he may even complain. Obviously, we must select certain aspects or characteristics of the organism's total activity and identify them as responses. The organism has a whole repertory of different responses to a given stimulus. When we make an arbitrary choice, we must not forget that by focusing on one type of response we cannot assume gratuitously that other responses will follow along and accommodate us by being similarly related to the stimuli with which we are concerned.

It is often assumed that we can predict the nuisance value of a particular noise stimulus from its loudness. Even if we disregard the fact that many noises are by no means steady (which makes it difficult to assess their loudness even by the most ingenious schemes), we are still faced with a number of paradoxes. Is the loud noise produced by the surf more objectionable than the proverbial dripping faucet or the whine of the bloodthirsty mosquito? Most people would agree that the surf sound should probably not be classified as a noise. As a matter of fact, it may be regarded as a pleasant sound, in a class, perhaps, with the sounds emitted by your own hi-fi equipment (but not with those generated by your neighbor playing Stravinsky's "Rites of Spring" when you think it's nap time).

These examples should be enough to indicate just how circular these everyday stimulus-response relations actually are. Under the circumstances it would be unreasonable, except in extreme cases, to entrust to an ordinary sound level meter the job of telling you whether your neighborhood is really quiet enough.

This may sound rather discouraging. How then do we go abou setting up a realistic criterion fo neighborhood noise based on cor munity reactions? Laboratory da on the annoyance that is exper enced (or at least reported) by pa subjects listening with earphon to pure tones, or even bands o noise, are clearly of limited valu

A realistic approach might i volve the following steps: (observe the way in which comm nities react to known noise cond tions; (2) supplement these da where possible by answers to car fully worded questionnaires; (use these indexes of behavior t set up a tentative response scal and finally, try to develop a cor putational method that is not to involved in order to calculate wh we might call the *effective stimulu*

Why are we suddenly referrir to the *effective stimulus* instead (just "the stimulus"? People in community live in an environmer so complex that it would be foo ish to attempt to specify it cor pletely. So, when we are intereste in a particular type of respon behavior, we have to make a choic and select certain variables on th stimulus side that seem to hav greatest descriptive and predictiv value. In laboratory experiment we often describe the stimulus a the energy change in the enviro ment at certain frequencies and fo a specified length of time.

In the community noise proble we have to broaden our definitio of the effective stimulus still fu ther. The effective stimulus is no just what is happening "here an now," but includes such factors a the noise levels to which the com munity has been exposed in th past and the number of times th particular acoustic events have oc curred. The nature of the sourc that produces the particular nois is sometimes an important and oc casionally the most important fac tor. We have, therefore, develope the concept of the *composite nois rating* as a description of the ef fective stimulus.

This evaluation of the nois stimulus is, of course, inadequate t account for all the nuances of th stimulus that derive from the con

text or connotation. Many factors may modify the reaction of a community. People may adjust to a new level of sound because it means more business, or their livelihood, or because they have lost certain fears that accompanied the acoustic event when it was new.

A Tentative Yardstick for Community Reactions

The reaction to a given noise may vary greatly from person to person in a community. Some people complain at the slightest provocation; others do not express annoyance even under quite severe noise exposure. Since it is difficult to make a reliable prediction of how one person in a community will respond to a noise stimulus, we shall focus our attention on a large group of residents, or a *living community,* and talk about the response of the group rather than the response of individual persons in the group. For a given noise stimulus we expect the responses of different communities to exhibit less variation than the responses of individual persons within the communities.

How do we measure and specify the response of a community? Can we set up a scale on which to measure the disturbance exhibited by a community when exposed to noise? Such a scale is proposed here, but we should note that the methods currently available for measuring community reactions are much less precise than the techniques used to measure certain aspects of the stimulus.

The response scale we propose is shown on the ordinate of Fig. 1.

At the low end of the scale is the region where no reaction is observed. The people in the community are not sufficiently disturbed to complain to those responsible for the noise or to the municipal authorities. Many of the residents probably do not notice the noise, but others may be somewhat disturbed. Careful questioning or observation of an insider would bring the attitudes of these people into the open.

The next point on the scale, "sporadic complaints," describes the situation in which some residents in the community are sufficiently disturbed to voice their opinions to those responsible for the noise, by means of telephone calls, letters, or the like. However, the complaints are not, for the most part, persistent. If a substantial number of residents in the community were to complain, and if some of the complaints were persistent, the point on the scale marked "widespread complaints" would be reached.

The term "threats of community action" describes a more severe condition in which large numbers of persistent complaints and threats are voiced. Groups might organize in an effort to bring about legislation or other restrictive action against those responsible for the noise. "Vigorous community action" describes the condition in which community action is strong enough to force the offenders to limit drastically or cease their operations.

The points on our response scale are not so well defined as we might wish. It is a relatively simple matter to measure the intensity of the noise that prevails in a community with a meter. It is simple also to obtain pertinent information on the time schedule of the noise, the background noise, and so forth. Our information on the community response, however, is gleaned from comments on the number of telephoned complaints and the number of letters of complaint, and from impressions of the severity of the disturbance voiced by the complainers. A carefully planned and executed opinion survey of communities exposed to noise would give much more precise data on the response. Such surveys are rarely made, however. For the present, when we evaluate case histories of communities disturbed by noise, we must rely primarily on counting the number of unsolicited complaints in order to assess the response of a community. We recognize that such data are often ill-defined and vague and that the frequency of the complaints and their severity cannot always be clearly separated.

The Composite Noise Rating (CNR)

What do we mean by the noise stimulus in a neighborhood? We have already noted that the stimulus cannot be described simply as the noise intensity measured at a given time. In order to predict the response of a community from measurements or computations of the noise stimulus to which the community is exposed, we must incorporate several characteristics in addition to intensity in the computation of the stimulus. Our objective here is to find a combination of the various physical aspects of the noise that will yield an adequate composite description of the *effective stimulus* in terms of a single rating, which we call the composite noise rating.

Noise Level Rank

Of primary importance in the determination of the community response are the over-all level and spectrum of the noise. We shall assume that the spectra are given as sound pressure levels in octave bands of frequency and are measured out of doors in the vicinity of residences. We assume further that the values are obtained by averaging over a reasonable time interval and over a reasonable number of locations in the community.

Figure 2 shows a family of curves that define the *noise level rank.* The ranks are designated by the letters from a to m, in ascending order, that is to say, f is a higher rank than b, but not necessarily three times b. Each rank denotes the area between two neighboring curves. At the low end is rank a. The lower boundary of the rank would be the average threshold of hearing for octave bands of noise. The highest rank is m, and the upper boundary of this rank represents a noise spectrum in which people can communicate only by shouting in each other's ears at a distance of a few inches.[1,2] This choice of scale implies that a noise that is inaudible does not contribute to annoyance, and that a noise in which it is virtually impossible to communicate, even by shouting, may be treated as socially unaccept-

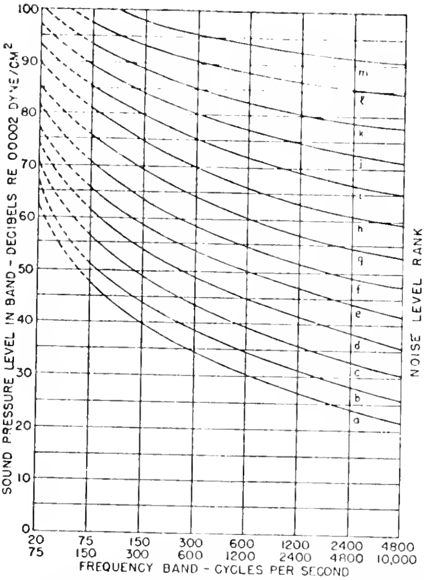


FIG. 2. Family of curves used to determine the noise level rank for residential noise. The spectrum of the noise is plotted as sound pressure levels in octave bands of frequency. The highest zone into which the spectrum protrudes is designated as the noise level rank.

able, whether or not questions of annoyance are involved.

To determine the level rank of a noise, we superimpose the measured or calculated octave band spectrum of the noise onto Fig. 2. The noise level rank is given by the highest area into which the spectrum protrudes in any band. This procedure implies that the noise level in a single octave band can sometimes determine the noise level rank uniquely. In effect, we are stating that different frequency bands contribute independently to the shaping of the response, and that the effects of different bands are not additive. The data of the case histories presented in the Appendix are not inconsistent with this assumption.

Where do the curves in Fig. 2 come from? As a starting point in the construction of these curves, we drew on the results of certain laboratory experiments on loudness. If two stimuli are identical in every respect except intensity (that is to say, if they have the same temporal character, the same background noise, etc.), it is reasonable to assume that the sound that people judge to be the louder will elicit the more severe community response. Consequently, the boundary lines between ranks in Fig. 2 have been selected so that stimuli of equal noise level rank would be judged, in general, to be equally loud (except at very low and very high frequencies, as is noted below).

Loudness data have not been reported for continuous spectrum noise below 100 cps, and consequently the slope of the curves at low frequencies is an extrapolation. At high frequencies the curves are drawn slightly below the curves of equal loudness, because laboratory data on annoyance indicate that high-frequency noise is usually judged to be more annoying than noise of lower frequency at the same loudness.[3, 4]

The distance between adjacent curves in the middle and high-frequency range is approximately 5 db. The steps are somewhat smaller at low intensities and somewhat larger at high intensities. At low frequencies the spacing between curves is decreased, as th bunching of the equal-loudne contours for bands of noise at lo frequencies would suggest. Sever considerations dictate the selectio of 5 db as a suitable discrete ste for the specification of noise lev rank. From previous experienc we believe that the range of var ation usually encountered in th reactions of a community to given noise is so wide that a chang of noise level of less than 5 d would not produce a significa change in the general pattern reaction to the noise. Also, the flu tuations of the noise levels bot in time and in space are often high as 5 db, and it would be u realistic, therefore, to specify th levels with greater precision.

Determination of the noise lev rank is the point of departure i the evaluation of the CNR of noise stimulus, and we shall tur now to other stimulus properti that affect the community respons Important characteristics of the e fective stimulus other than the av erage level and the spectrum fa into four general categories: bac ground noise, temporal and se sonal factors, detailed descriptio of the "packaging" of the nois and previous exposure. Quantit tively, we account for these pro erties by means of correction num bers which we apply to the nois level rank. For example, a correc tion number of + 1, i.e., one ran upward, applied to a noise leve rank of d yields e. The evaluatio of the correction numbers is dis cussed in the following paragraphs and a summary of all correctio numbers is presented in tabula form following the discussion.

Background Noise

When we talk about a nois stimulus in a community, we ar generally focusing our attention o noise originating from a particula *source*. Some of the sound energy reaching a community may originate from other sources. The sound originating from these sources is called "background noise." Generally the residents accept this background noise as a part of their daily environment, and the noise does not disturb them particularly,

i.e., they don't react to it, or they have adapted to it. It is clear, however, that the background noise must be considered as a factor modifying the "effective stimulus."

It may happen, for example, that the noise from a particular source is masked by the background noise in one community, but is much more intense than the background noise in another community. The two communities will respond quite differently to these two stimulus situations. In a sense, the background noise level plays the role of a reference level with which the noise under consideration is compared.

In order to take into account differences in background noise, we measure the spectrum of the average background noise in octave bands of frequency, and we plot this spectrum in Fig. 3. The figure is divided into zones labeled with correction numbers from −3 to +2. The zone in which the major portion of the noise spectrum lies designates the correction number to be applied for background noise. The spectrum shape of the curves in the figure is an average spectrum derived from many measurements of background noise in different localities. Table I indicates the type of locality in which each level of background noise is often found.

Temporal and Seasonal Factors

When the offending source of noise operates more or less uniformly and continuously over an appreciable period of time, the noise stimulus may be described adequately simply by the sound level in octave bands of frequency. Usually, however, the noise source does not radiate sound continuously but operates on some sort of time schedule. For example, it may operate only between the hours of 9:00 A.M. and 5:00 P.M., or it may be heard in a residential area for only three or four 20-second periods each hour (as is the case when three or four aircraft per hour pass over a community). How do we correct for such irregular time schedules in our computation of the CNR? Our approach is outlined in the following discussion.

TABLE I. Correction numbers to account for ~~daytime ambient noise levels in typical neighborhoods. On the average, the correction numbers should be increased by one for nighttime conditions.~~
SOCIAL ECONOMIC LEVEL OF THE NEIGHBORHOOD

~~Neighborhood~~ KIND OF PEOPLE	Correction number
Very quiet suburban HIGH CLASS	+1
Suburban HIGH MIDDLE	0
Residential urban MIDDLE	−1
Urban near some industry AVERAGE	−2
Area of heavy industry SLUM	−3

~~INCREASE BY 1 FOR NIGHTTIME~~.

Day or Night.—During the daytime, many people are away from their residences and do not hear the noise. Residents who stay near their homes are often engaged in activities that are not greatly disturbed by moderate noise levels. In the evening and at night, however, the noise tends to interfere with relaxation and sleep. We expect, therefore, that a noise of a given level rank will produce a more severe response if it occurs at night than if it occurs only in the daytime. Empirical evidence suggests that we apply to the level rank a correction number of −1 if the noise source operates only in the daytime. No correction number is applied if the source operates at night (say between 8:00 P.M. and 8:00 A.M.).

Repetitive Character.—In the discussion that follows, we shall be concerned primarily with noise sources that operate on a more-or-less regular schedule every day of the week. We shall give only brief consideration to schedules that are less regular.

If a noise source operates only during a certain fraction of the time each day, the community response will, in general, be less severe than the response to a continuous stimulus. To account for this restricted time schedule in our description of the stimulus, we apply a negative correction number to the level rank. At present, quantitative evaluation of the influence of repetitiveness is not well established because field data are not available for a wide range of conditions. Preliminary data seem to indicate, however, that the correction number is a function of the percentage of time the noise source operates within, say, an 8-hour period. Our experience indicates that the correction number is reason-

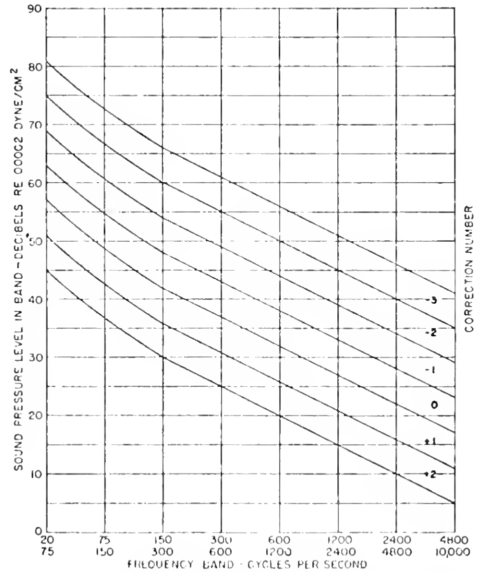


FIG. 3. Family* of curves used to determine the correction number for background noise. The spectrum of the ambient background noise is plotted as sound pressure levels in octave bands of frequency. The zone in which the major portion of the noise spectrum lies designates the correction number to be applied for background noise.

* FOR BEST RESULTS USE BOTH TABLE I AND FIG 3.

ably independent of the particular schedule of operations but is concerned only with the total number of minutes of operation within the period. For example, if the source operated for a total of 30 minutes each day, the correction number would be the same whether these 30 minutes occur within one hour or whether the source operates for only 4 minutes each hour.

We have derived an empirical relation between the percentage of time the source operates and the correction number, and this relation is given in Fig. 4. This relation and the assumptions that govern its use should be regarded as tentative, subject to modification as more data become available.

Additional correction numbers should be applied if the noise source does not operate on the same schedule each day. If operations are restricted to one or two days a week, an additional correction number of − 1 seems to be required.

Winter or Summer.—In northern climates, there is a marked difference in people's living habits in winter and summer. In the winter, almost all activities associated with residential living are carried on inside well-insulated houses, usually with the windows closed. In the summer, however, residents are frequently out of doors, and windows are left open day and night. Consequently, for a given level of noise measured outside, the stimulus to which residents are exposed is greater in summer than in winter. To account for this difference, we apply a correction number of − 1 if the source operates only during the winter and no correction number for summer or year-round operation. In warm climates no correction is applied for either winter or summer.

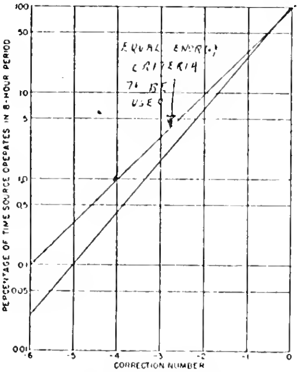


FIG. 4. Proposed correction numbers for repetitiveness of the noise when the source operates on a reasonably regular daily schedule. To a first approximation, the correction number is dependent only on the percentage of time the source operates in an 8-hour period, and not on the particular time schedule within the period.

TABLE II. List of correction numbers to be applied to noise level rank to give composite noise rating.

Influencing factor	Correction number
1. Background noise (see Fig. 3) VARIATED IS ABOVE THE BACKGROUND NOISE	+2 to −3
2. Temporal and seasonal factors	
a. Daytime only	−1
Nighttime	0
b. Repetitiveness (see Fig. 4 and text)	0 to −6
c. Winter	−1
Summer	0
3. Detailed description of the noise	
a. Continuous spectrum	0
Pure-tone components	+1
b. Smooth time character	0
Impulsive	+1
4. Previous exposure	
None	0
Some	−1

Description of the Noise

Spectrum Character.—A noise spectrum that contains audible pure-tone or single-frequency components is apparently judged to be more annoying than a spectrum that is reasonably continuous. This deduction is based on engineering experience with noise spectra of both types. If, for example, the sound-pressure level in an octave band reaches the noise level rank d by virtue of the contribution of a single-frequency component, we propose that a correction number of + 1 be applied, i.e., that the level rank of the noise be raised from d to e. The implication is that, all other things being equal, the level of a pure tone must be about 5 db below the level of a continuous spectrum noise in the same octave band to produce the same neighborhood reaction.

Peak Factor.—A noise that is reasonably continuous in time, at lea for a few seconds or more, is ap parently judged to be less anno ing than an impulsive noise, for ex ample, the sound of a drop forg or gun shots. Experience indicat that a correction number of + should be applied to the level ran if the noise is impulsive. At pre ent no firm definition of impulsiv noise in quantitative terms is pro posed, and some judgment is re quired to distinguish between im pulsive and continuous noise.

Previous Exposure

Experience has shown that res dents of a community differ fron one another in their ability t adapt to an intruding noise afte repeated exposures. For exampl people near a railroad can be come accustomed to the noise eve though they may have shown som reaction during the first few day of exposure. The noise of an occa sional aircraft overhead is now ac cepted by most people, and the may therefore be considered to b adapted to this sound. This adapta tion is unstable, however. An acci dent or near accident may upse the community sufficiently to war rant on-the-spot reconsideration No correction should be applied to the noise level rank if an in truding noise is a new one to which the residents have not been ex posed previously. If there has been some previous exposure to the noise (or to noise of a similar type),

a correction number of − 1 is proposed.

Summary of Computation of the Effective Stimulus

Table II summarizes the various physical characteristics of the stimulus and indicates the quantitative influence of each in the form of correction numbers that must be applied to the noise level rank to obtain the composite noise rating. In order to avoid confusion, we usually designate noise level ranks by lower case letters and composite noise ratings by capital letters. The noise level rank and the CNR are identical when (1) the acoustic environment is similar to that of a suburban community, (2) the noise source operates at night, (3) the noise source is continuous, (4) the noise source operates in the summertime, (5) the noise spectrum is continuous, (6) the noise has a uniform short-time character, and (7) there has been little previous exposure of the community to the noise.

Empirical Stimulus-Response Relations

Up to this point we have proposed a scale on which to measure the response of communities to a noise stimulus, and we have described a scheme for specifying that stimulus. The next question is: is it possible to find a unique relation (or one that can be defined in statistical form) between the stimulus and the response? This question can be answered only after a study of the reaction of residents in a number of communities that have been exposed to various amounts of noise under sufficiently different circumstances.

We have examined a number of case histories of noise in residential communities. In each of these case histories we have reasonably reliable measurements of the noise stimulus and of the reaction of the community to the noise. The available data have been summarized in Fig. 1. The composite noise rating is plotted as the abscissa and the response scale is plotted as the ordinate. For each case history we compute the CNR of the noise stimulus according to the procedure outlined above. From the reaction of the community we find the appropriate level on the response scale. And from these estimates of stimulus and response we obtain a point on Fig. 1. We proceed in the same manner for each case history.

The reaction of some communities to the noise was rather strong. In these instances the points in Fig. 1 lie near the upper end of the response scale. In others, there was only a mild reaction, or perhaps no reaction at all. Thus Fig. 1 summarizes data and experiences for a wide range of values of both responses and noise stimuli. Table III summarizes the calculations for some typical case histories.

The points in Fig. 1 cluster around a mean line labeled "Average Expected Response from a Normal Community." There is a certain amount of spread of the points about the mean, but most

TABLE III. Summary of typical case histories of response to noise in residential areas.

	1	2	3	4	5	6	7	8	9	10	11
No.	Description of facility and noise	Level rank	Background noise	Day or night	Repetitive character	Winter or summer	Spectrum character	Peak factor	Previous exposure	Composite noise rating	Observed community response
1	Large wind tunnel in Midwest, jet engine operating	h	+1	0	0	−1	0	0	0	H	Municipal authorities forced facility to shut down
2	Large wind tunnel in Midwest, no burning	f	+1	0	0	0	0	0	0	G	Vigorous telephone complaints and injunction threats
3	Exhaust for air pumps, factory in industrial area	j	−3	−1	0	0	+1	0	−1	F	Lodging house owner entered complaints with operator of factory and with local Department of Health
4	Engine run-ups at aircraft manufacturing plant	e	0	−1	−1	0	0	0	−1	B	No complaints reported
5	Aircraft in flight one mile from airport	l	−1	0	−4	0	0	0	−1	F	Vigorous complaints by letter and telephone; one community attempted to prevent passage of aircraft
6	Aircraft in flight four miles from airport	j	−1	0	−4	0	0	0	−1	D	Sporadic complaints in some communities, widespread complaints in others
7	Aircraft engine manufacturing plant: test cells	f	−1	−1	0	0	0	0	−1	C	No complaints reported for daytime operation
8	Transformer noise from power company	f	+1	0	0	0	+1	0	−1	G	Injunction threats
9	Large fan at power company	e	0	0	0	0	+1	0	−1	E	Residents complained consistently, company took steps to reduce noise
10	Weapons range, intermittent firing	l	−1	−1	−5	−1	0	+1	0	E	Vigorous complaints from nearby residents

of them lie within a shaded area labeled "Range of Expected Response from Normal Communities."

We have observed previously that the response of a community is not determined solely by the physical characteristics of the noise stimuli. There are other factors that are not necessarily directly related to the stimulus but that tend to influence the general attitude of the community. In most of the communities that we studied, it was not possible to examine the general attitudes or biases independently or to account for them in quantitative fashion. Consequently, we expect a certain spread in the data, like the spread on the graph in Fig. 1. For example, if a community is near a noisy factory and if there are good public relations between the residents and the factory management, the response may be less severe than the average line in Fig. 1. If, on the other hand, the factory makes no attempt to reduce the noise, and no regard is evidenced for the feelings of the

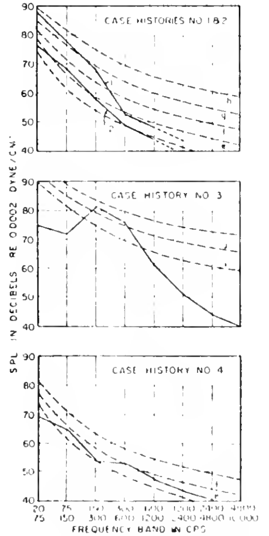


FIG. 5. Measured spectra of intruding noise for four of the case histories listed in Table III. The dashed lines indicate the boundaries of the noise level ranks from Fig. 2. In each case, the noise level rank is the highest rank into which the noise spectrum protrudes.

residents, the reaction may be more severe than the expected average.

Another factor difficult to account for in our evaluation of the effective stimulus is the connotation of the noise. What message does the noise source convey to the people in the community? People may respond quite differently to the same noise, depending on the meaning it has for them. Perhaps the noise brings to the community a message of danger; perhaps it brings a happy message. If an aircraft has recently crashed in the vicinity, the response to the sound of aircraft overhead will probably increase sharply, even though our instruments detect no change in the stimulus. On the other hand, the noise of aircraft returning from a safe mission may bring feelings of joy to the people in a community.

These and other factors may result in different reactions in communities that are exposed to the same noise stimulus or to noise stimuli with the same CNR.

From study of the case histories, however, we believe that a majority of cases would lie within the shaded region shown in Fig. 1. Only in a small percentage of cases, say five to ten percent, would we expect the response to lie outside the shaded region.

The data summarized in Fig. 1 indicate that we can, within certain limits, establish a relation between stimulus and response. We must recognize, however, that there will be a range of uncertainty in the expected response of a community to a given stimulus so long as we are unable to measure and account for factors that have little if any relation to the physical stimulus.

Conclusion

We have presented a scheme for computing the effective noise stimulus to which a community may be exposed and for measuring the response of the community to noise.

On the basis of the twenty-odd case histories we have studied, we feel that the scheme presented here will, within the statistical range of variation indicated by the shaded area in Fig. 1, predict the response of a community to a given noi situation in most cases. Ho ever, we should like to rega the method as a framework with which new data and experience c neighborhood reaction to noise ca be gathered. We may find that th new data provide further valid tion of the scheme, or we may fir that the computational procedu requires modification, perhaps wi the introduction of additional co rection numbers.

We started by asking wheth a community's reaction to noi could be forecast. Perhaps you' disappointed because we have n been able to give you a clear-c answer—we have not said ho many decibels it takes to mal people squawk how loudly. just doesn't seem to be that sin ple. The answer involves decib readings, spectra, background nois and time schedules, and includ some factors that we cannot eve measure with the customary instr ments of the physicist or the eng neer. The scheme that we have pr sented attempts to take account the factors that seem to be impo tant. Armed with this arsenal meter readings, correction num bers, and a yardstick for con plaints, we have been able t quantify certain aspects of eng neering experience. We need t know whether this scheme wi work when *you* try it. For a lon time noise forecasting is going t be like its older and more estal lished brother, weather forecasting We may wish the weather ma were more accurate in his predic tions, but we would not want t be without him.

APPENDIX

Summary of Case Histories

The empirical relation shown in Fig. 1 was derived from a numbe of case histories of neighborhood reaction to noise. Pertinent data from some of the case histories are summarized in Table III and Fig 5. The columns of the table give information about both the stimu lus and the response.

The first column indicates the type of facility that generated the noise. Column 2 gives the noise level rank, which is obtained by

plotting the octave band spectrum of the noise in Fig. 2 and noting the highest rank into which the noise spectrum protrudes. To illustrate this procedure, Fig. 5 shows spectra for four of the cases. In columns 3 to 9 are listed the various correction numbers for each case history, following the scheme outlined in the text. The composite noise rating, obtained by applying the correction numbers to the noise level rank, is given in column 10. In column 11 there is a brief description of the community response, from which we select an appropriate point on the response scale of Fig. 1.

Each of the ten case histories listed in Table III is represented by a numbered point in Fig. 1. The lines representing the average and the range of expected responses in Fig. 1 are based on these ten points, plus a number of points derived from other case histories.

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APPENDIX G

PARTICULATE CONTROL ALTERNATIVES

EES-UEC-1
Volume I
Text

ANALYSIS OF PROPOSED SYSTEMS FOR CONTROL OF PARTICULATE EMISSIONS FROM MEDICAL AREA TOTAL ENERGY PLANT

for

UNITED ENGINEERS & CONSTRUCTORS, INC.
100 Summer Street
Boston, Massachusetts 02110

Your Order No. 6484.001-49-3

by

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November 15, 1976

Charles E Billings

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SUMMARY

The proposed Medical Area Total Energy Plant will contain six Diesel engines, three oil-fired boilers and three controlled air incinerators. Estimates of uncontrolled outlet concentrations from each source:

- Diesels - 0.057 grains per standard cubic foot.
- Boilers - 0.046 grains per standard cubic foot.
- Incinerators - 0.76 grains per standard cubic foot.

Particle size distribution estimates have been developed for maximum expected particle size and minimum expected particle size conditions. Design criteria for emissions from each source have been selected as follows:

- Diesel Engines - 0.0125 grains per standard cubic foot, dry, corrected to 12% CO_2.
- Oil-Fired Boilers - 0.0125 grains per standard cubic foot, dry, corrected to 12% CO_2.
- Incinerators - 0.04 grains per standard cubic foot, dry, corrected to 12% CO_2.

These values represent approximately one-half of emissions allowed by Massachusetts air pollution control regulations, and should also provide a nearly nonvisible stack plume. To achieve

the Diesel engine emission criterion, an afterburner fired with No. 2 fuel oil will be used to remove unburned particulates. Boiler emissions will be controlled with electrostatic precipitators. Commercial controlled-air incinerators may be available which achieve outlet concentrations of 0.04 grains per standard cubic foot, dry, corrected to 12% CO_2, by secondary combustion in an integral afterburner.

I

INTRODUCTION

This report presents results of estimates of particulate emissions from the proposed Medical Area Total Energy Plant, and considers control by selected devices. The purpose of this study is:

- To acquire and review present design data;
- To estimate particle emission concentrations;
- To estimate particle size - efficiency of proposed control systems;
- To calculate overall collection efficiency;
- To compare calculated emission concentrations to regulatory values; and
- To prepare a report with recommendations for appropriate particulate control equipment.

II

CONCLUSIONS

A. Diesel Engines

Outlet particulate concentrations in uncontrolled exhausts from diesel engines are estimated to be about 0.057 grains per standard cubic foot. This concentration is in excess of allowable state emission regulations.

B. Oil-Fired Boilers

Outlet particulate concentrations from uncontrolled oil-fired boilers are estimated to be about 0.046 grains per standard cubic foot. This concentration is equivalent to 0.08 pounds per million BTU, which is in excess of state emission regulations.

C. Incinerators

Outlet concentrations in uncontrolled exhausts from incineration of mixed refuse are estimated to be 0.76 grains per standard cubic foot from conventional incinerators. This concentration may be reduced in the exhaust from controlled-air incinerators by the use of auxiliary fuel in a secondary combustion afterburner chamber.

III

RECOMMENDATIONS

A. <u>Diesel Engines</u>

Combustible exhaust particulates, carbon monoxide, and hydrocarbon emissions from Diesel engines, can be effectively reduced by treatment in a direct flame afterburner for a period of one-half second at a temperature equal to or greater than 1600°F, according to best available data. Use of No. 2 fuel oil for the afterburner and a heat recovery steam generator may provide an effective control method.

B. <u>Oil-Fired Boilers</u>

Exhaust particulate emissions from boilers during normal operation can be controlled by an electrostatic precipitator, designed for operation at an overall collection efficiency of about 80% over the total particulate size range. This would achieve an outlet concentration of 0.0125 grains per standard cubic foot, dry, corrected to 12% CO_2, based on an inlet concentration of 0.046 grains per standard foot.

C. <u>Incinerators</u>

Based on the acquisition of test data on emissions from controlled-air incinerators firing mixed refuse, the outlet concentration from the secondary combustion chamber may be in agreement with manufacturers reported emission values (0.04 grains per standard cubic foot, dry, corrected to 12% CO_2), in which case no further control would be required.

IV

PLANT DESCRIPTION AND OPERATING CONDITIONS

The proposed medical area total energy plant (MATEP) will be located in Boston on Brookline Avenue at Francis Street. It will generate electricity, steam, and chilled water for distribution to adjacent hospital and university facilities.

Principal particulate emission sources are:

- Six Diesel engines operated on No. 6 fuel oil;
- Three package steam generators operated on No. 6 fuel oil; and
- Three controlled-air incinerators.

Figure 1 is a schematic diagram of the proposed plant with flue gas flow rates, temperatures, and pressures.

Plant operations will vary with institutional demands for electric power, steam, and chilled water. The ten modes which have been considered for proposed plant operations are presented in Table 1. They consist of four seasonal averages, four maximum averages, and two minimum averages. These cases have been used to estimate particulate emissions from the proposed plant.

V

TECHNICAL APPROACH

The Massachusetts Department of Environmental Quality Engineering requires all new facilities in the Metropolitan Boston Air Pollution Control District utilizing fossil fuel and having aggregate fuel heat input greater than 250 million Btu per hour to have emissions of less than 0.05 pounds per million Btu (Regulation 2.5.1). This is equivalent to an approximate outlet particulate concentration of 0.025 grains per standard cubic foot, dry, corrected to 12% CO_2. Particulate emission sources shown in Figure 1 are not yet installed. Emissions from the combustion equipment at this facility cannot be directly measured to determine the need for particulate control. Estimates of particulate emission concentrations have been obtained from data reported for similar sources. These have been applied to the proposed operating conditions listed in Table 1 to determine emission rates (pounds per hour) and emission factors (pounds per million Btu).

Emissions estimated to exceed the amount permitted in Massachusetts Regulation 2.5.1 have been analyzed for alternatives to reduce concentrations to comply with the standards. This report considers the addition of particulate control technology to reduce the outlet concentrations in the stack gas. Table 2 summarizes methods of data acquisition and analysis used to characterize particulate emissions from individual sources, to establish need for particulate control technology, and to recommend effective solutions.

VI

ESTIMATED EMISSION CONCENTRATIONS AND PARTICLE SIZE DISTRIBUTIONS

A. Stationary Diesel Engine Emissions

Available data on concentration and particle size for stationary Diesel engine emissions were limited. Emission quantities were estimated from recent studies on farm, construction, and industrial engines and from Diesel locomotives and ships. Particle size was estimated from two recent reports on mobile source internal combustion engine exhausts. Data are presente in detail in Appendix A.

Concentration and particle size estimates are presented in Table 3. The average outlet concentration is estimated to be about 0.057 grains per standard cubic foot. Maximum median particle diameter likely to be generated is estimated to be 0.19 micrometers mass median diameter and is referred to as the best case assumption (largest particle size) in further calculations. Minimum median particle diameter likely to be generated is estimated to be 0.025 micrometers mass median diameter and is referred to as the worst case assumption (smallest particle size) in further calculations.

B. Oil-Fired Boiler Emissions

Concentration and particle size data have been obtained from a reasonable number of reports on particulate emissions from

utility steam generators and industrial boilers firing No. 6 residual fuel oil. Recent tests of emissions from the present medical area power plant are also included. Data are presented in detail in Appendix B.

Concentration and particle size estimates are presented in Table 4. The average outlet concentration for normal full-load operation is estimated to be about 0.046 grains per standard cubic foot. During soot blowing operations, the concentration is estimated to increase to an average of 0.144 grains per standard cubic foot. Maximum median particle diameter likely to be generated is estimated to be 5.0 micrometers and is referred to as the best case assumption in further calculations. Minimum median particle diameter likely to be encountered is estimated to be 0.05 micrometers and is referred to as the worst case assumption in further calculations. A further assumption is made in case by case analysis that if worst case emissions for full load normal boiler operation require control, and control technology is selected for this situation, then soot blow will be controlled at least as well, as its particle size is nearer the best case condition.

C. Incinerator Emissions

Concentration and particle size data have been obtained from a number of reports on emission tests from conventional incinerators burning mixed refuse and other solid wastes. Limited data are also included for emissions from controlled-air

combustion incinerators with an auxiliary fuel-fired afterburner section following the main chamber. Data are presented in detail in Appendix C.

Concentration and particle size estimates are presented in Table 5. The average outlet concentration is estimated to be about 0.76 grains per cubic foot. Maximum median particle diameter likely to be generated is estimated to be 50 micrometers and is referred to as the best case assumption in further calculations. Minimum median particle diameter likely to be encountered is estimated to be 1.0 micrometer and is referred to as the worst case assumption in further calculations. Manufacturers of controlled-air incinerators having auxiliary fuel fired afterburner chambers operated on Type I waste (paper) claim emission concentrations will be about 0.04 grains per cubic foot. Tests of these devices on mixed refuse have indicated emission concentrations about the same as those indicated above.

VII

ESTIMATES OF UNCONTROLLED SOURCE EMISSIONS

Estimates of average particulate emission concentrations from Tables 3, 4, and 5 have been used to calculate emission rate in pounds per hour for individual sources and operating conditions as shown in Tables 6, 7, and 8. Particulate emission rates for Diesel engines, oil-fired boilers, and incinerators have been converted to emission factors based on operating fuel rate and heat input, as shown. Average uncontrolled particulate emissions from Diesel engines are estimated to be about 0.2 pounds per million Btu, from Table 6. Average uncontrolled particulate emissions from oil-fired boilers are estimated to be about 0.08 pounds per million Btu, from Table 7. Average uncontrolled particulate emissions from incinerators are estimated to be about 1.5 pounds per million Btu, from Table 8. Total plant emissions from all sources combined are shown in Table 9. Overall total uncontrolled particulate emissions are estimated to range from 0.1 to 0.4 pounds per million Btu. If the incinerator emissions are excluded from the totals, average combined particulate emissions range from 0.1 to 0.2 pounds per million Btu.

Emissions from all sources for all operating conditions are estimated to exceed the standard value of 0.05 pounds per million BTU contained in Massachusetts Regulation 2.5.1.

VIII

ESTIMATED PARTICLE SIZE-EFFICIENCY FOR SELECTED PARTICULATE CONTROL DEVICES AND CALCULATED WEIGHT COLLECTION EFFICIENCY

Five types of particulate control devices have been considered for application to individual emission sources at the proposed plant, including:

- Cyclones
- Scrubbers
- Electrostatic precipitators
- Fabric filters
- Afterburners

Data on average collection efficiency as a function of particle size range is available on specific configurations of cyclones, scrubbers, precipitators, and filters, as shown in Table 10. These collection efficiencies have been applied to estimated source particle size distributions presented in Tables 3 (Diesel engines), 4 (oil-fired boilers), and 5 (incinerators). Calculated overall weight collection efficiencies are presented in Table 11 for each control device configuration applied to each source for the best case particle size assumption (largest particle size) and the worst case particle size assumption (smallest particle size). Data and calculations are presented in detail in Appendix D.

The afterburner selected for control of combustible particulate emissions from the Diesel engine exhaust is expected to have a

conversion effectiveness of 90% at an operating temperature in excess of 1600°F with flue gas residence time in the range of 0.5 to 1.0 seconds, as indicated in Appendix E (see Table 3-1 and sections 3.1.2.5 and 3.1.2.6 of this EPA report on afterburners). Reliable data on use of conventional collector technology for Diesel engine exhaust particulate control is unavailable.

IX

ESTIMATES OF CONTROLLED SOURCE EMISSIONS

Average uncontrolled source emission concentrations from Tables 3 (Diesel engines), 4 (oil-fired boilers), and 5 (incinerators) have been used as input concentrations to each of the candidate control devices listed in Table 11. Estimated outlet concentrations from the control device is calculated by multiplying the fractional penetration (1-efficiency/100) by the inlet concentration. Average outlet concentrations for selected control devices applied to individual particulate emission sources are shown in Table 12 for the worst case (finest) and best case (largest) particle size assumptions, respectively.

Criteria used to select control devices include provision of an outlet concentration of about 0.0125 grains per standard cubic foot, dry, corrected to 12% CO_2, which is estimated to produce an emission factor of less than one-half of the allowable value, and which should be nearly nonvisible.

Consideration of cyclones indicates that it is unlikely they can provide high enough removal efficiency on the fine particles produced in these combustion effluents. Scrubbers were removed from consideration because of waste water treatment and disposal problem. Fabric filters have only been used once on oil-fired combustion emissions and were not considered to be proven technology for this plant effluent. Among the electrostatic precipitators, a precipi-

tator with a collection efficiency equal to or greater than the EPA theoretical medium efficiency design is recommended with design collection of the order of 80% on these low concentration, fine particle size effluents.

Devices selected include:

Diesel engines: Direct flame afterburner with residence time greater than one-half second at an outlet temperature not less than 1600°F, with an assumed removal efficiency of approximately 90% on oil smoke and carbon particles.

Oil-fired boiler: Electrostatic precipitator having a collection efficiency of at least 80% on the best case particle size distribution.

Incinerators: Controlled-air type, designed with afterburner temperature and retention time to obtain guaranteed outlet concentration of 0.04 gr/scf.

Estimates of controlled emission concentration from individual sources and operating conditions have been used to calculate emission rates in pounds per hour and emission factors in pounds per million Btu, as shown in Tables 13, 14, and 15. Each control device selected produces an outlet concentration less than about 0.0125 grains per standard cubic foot, dry, corrected to 12% CO_2, and yields an emission factor less than about one-half of the allowable value, except for incinerators. Incinerators will be

subjected to an outlet concentration criterion of 0.08 grains per cubic foot, dry, corrected to 12% CO_2. The integral afterburner should be specified to emit about 0.04 grains per cubic foot, dry, corrected to 12% CO_2. Total plant emissions from all controlled sources are shown in Table 16. Overall aggregate emission concentrations are calculated to range from 0.015 to 0.018 grains per cubic foot. Total emission rate is estimated to range from 12 to 22 pounds per hour. Emission factors range from 0.02 to 0.05 pounds per million Btu. Higher values in each case are caused by incinerator emissions.

Table 1. Plant Operating Modes

OPERATING MODES		DIESEL ENGINES		STEAM BOILERS		INCINERATORS	
NO.	DESCRIPTION	UNITS OPERATING	LOAD (%)	UNITS OPERATING	LOAD (%)	UNITS OPERATING	LOAD (%)
1.	Fall Season (Average)	5	63	0	-	1	100
2.	Winter Season (Average)	3	58	2	63	1	100
3.	Spring Season (Average)	4	61	1	53	1	100
4.	Summer Season (Average)	6	71	0	-	1	100
5.	Max. 24-HR. (Winter)	2	56	3	77	2	62
6.	Max. 3-HR. (Winter)	2	93	3	87	2	62
7.	Max. 24-HR. (Summer)	5	93	0	-	2	62
8.	Max. 3-HR. (Summer)	6	94	1	22	2	62
9.	Min. 24-HR. (Annual)*	3	81	0	-	2	62
10.	Min. 24-HR. (Annual)*	3	73	0	-	2	62

*Note that the minimum load considers incinerators operating at maximum expected capacity to achieve a combined maximum outlet concentration.

Table 2. Summary of Data Aquisition and Analysis Methods

A. Particulate Emission Characteristics

1. Estimate particulate emission concentrations
2. Calculate emission factors, compare to standard
3. Decide if control technology required
4. Estimate particle size distributions
5. Plot data and select best case (largest) and worst case (finest)
6. Determine mass fraction in each size increment

B. Particulate Collection Efficiency

7. Estimate particle size-efficiency of candidate control devices
8. Multiply efficiency in size range by mass fraction expected
9. Sum for total efficiency
10. Apply efficiency to estimated particulate emission concentration to obtain expected outlet concentration
11. Calculate emission factor, compare to standard
12. Select appropriate device

Table 3. Estimated Concentration and Particle Size Distribution Data for Emissions from Stationary Diesel Engines

A. Concentration

Normal full load operation (grains/scfd)	maximum	0.097
	average	0.057
	minimum	0.031

B. Particle Size Distribution

Particle Size Range (mmd or aed), µm	Best Case cum % ≤	Best Case % in Range	Worst Case cum % ≤	Worst Case % in Range
0 - 0.01	0	0	4.6	4.6
0.01 - 0.02	0.3	0.3	36.2	31.6
0.02 - 0.04	2.2	1.9	83.6	47.4
0.04 - 0.06	7.0	4.8	96.0	12.4
0.06 - 0.08	13.4	6.4	99.0	3.0
0.08 - 0.1	21.0	7.6	99.7	0.7
0.1 - 0.2	54.0	33.0		0.3
0.2 - 0.4	84.0	30.0		
0.4 - 0.6	94.0	10.0		
0.6 - 0.8	97.2	3.2		
0.8 - 1	98.4	1.2		
1 - 2	99.9	1.5		
> 2		0.1		
		100		100

Table 4. Estimated Concentration and Particle Size Distribution Data for Emissions from Oil-Fired Boilers

A. Concentration

Normal full load operation (grains/scf)	maximum	0.130
	average	0.046
	minimum	0.018
During soot blow operation (grains/scf)	maximum	0.209
	average	0.144
	minimum	0.064

B. Particle Size Distribution

Particle Size Range (mmd or aed) µm	Best Case Cum % ≤	Best Case % in Range	Worst Case Cum % ≤	Worst Case % in Range
0 .01		0	10.0	10.0
.01 - .02	.01	0	21.2	11.2
.02 - .04	0.03	0.01	38.4	17.2
.04 - .06	0.1	0.13	50.0	11.6
.06 - .08	0.2	0.1	58.2	8.2
.08 - 0.1	0.3	0.1	64.2	6.0
0.1 - 0.2	1.2	0.9	81.4	17.2
0.2 - 0.4	4.2	3.0	91.5	10.1
0.4 - 0.6	7.4	3.2	95.2	3.7
0.6 - 0.8	11.0	3.6	96.8	1.6

Table 4. (Continued)

B. Particle Size Distribution (cont.)

Particle Size Range (mmd or aed), μm	Best Case Cum % ≤	Best Case % in Range	Worst Case Cum % ≤	Worst Case % in Range
0.8 - 1.0	14.0	3.0	97.8	1.0
1.0 - 2	28.0	14.0	99.4	1.6
2 - 4	47.0	19.0	99.9	0.5
4 - 6	59.0	12.0		0.1
6 - 8	66.6	7.6		0
8 - 10	72.2	5.6		0
10 - 20	86	13.8		0
20 - 40	94.2	8.2		0
40 - 60	97	2.8		0
> 60		3.0		0
		100		100

Table 5. Estimated Concentration and Particle Size Distributic Data for Emissions from Incinerators

A. Concentration

Normal operation (grains/scf)		
	maximum	2.55
	average	0.76
	minimum	0.02

B. Particle Size Distribution

Particle Size Range (mmd or ead) µm	Best Case Cum % ≤	Best Case % in Range	Worst Case Cum % ≤	Worst Case % in Range
0 - 0.02		0		0
0.02 - 0.04		0		0
0.04 - 0.06		0	0.2	0.2
0.06 - 0.08		0	0.4	0.2
0.08 - 0.1	0.01	0	0.8	0.4
0.1 - 0.2	.13	.1	4.8	4.0
0.2 - 0.4	1.2	1.1	17.3	12.5
0.4 - 0.6	3.3	2.1	30.0	12.7
0.6 - 0.8	6.4	3.1	41.8	11.8
0.8 - 1.0	9.0	3.3	50.0	8.2
1 - 2	13.0	3.3	56.8	6.8
2 - 4	17.1	4.1	64.4	7.6
4 - 6	19.7	2.6	68.8	4.4
6 - 8	21.8	2.1	80.0	11.2
8 - 10	23.8	2.0	86.4	6.4
10 - 20	29.0	5.2	97.2	10.8
20 - 40	44.5	15.5	99.7	2.5
40 - 60	54.4	9.9	99.9	0.2
> 60		45.6		0.1
		100%		100%

Table 6. Estimates of Uncontrolled Particulate Emissions From Diesel Engines

Mode of Operations	Operating Conditions	Number of Diesels Operating (No)	Percent Load for Ea Diesel (%)	Combined Diesel: Fuel Rate (Lbs/Hr)	Combined Diesel: Heat Input (10^6)Btu/Hr	Combined Diesel: Flue Gas Flow Rate (10^3)Lbs/Hr	Combined Diesel: Flue Gas Flow Rate 10^3SCF/M	Particulate Emissions: Concentration Grains/scf	Particulate Emissions: Rate (Lbs/Hr)	Particulate Emissions: Factor Lbs/(10^6)Btu
1	Fall Season (Average)	5	63.1	10,510	194.4	400	84.9	.057	41.5	.213
2	Winter Season (Average)	3	58.3	5,830	107.8	225	47.8	.057	23.4	.217
3	Spring Season (Average)	4	60.6	8,070	149.4	308	65.4	.057	32.0	.214
4	Summer Season (Average)	6	71.4	14,270	264.0	522	110.8	.057	54.1	.205
5	Max. 24-Hr (Winter)	2	55.8	3,720	68.8	145	30.8	.057	15.0	.218
6	Max. 3-Hr (Winter)	2	93.3	6,220	115.0	214	45.4	.057	22.2	.193
7	Max. 24-Hr (Summer)	5	93.3	15,550	287.7	535	113.6	.057	55.5	.193
8	Max. 3-Hr (Summer)	6	94.0	18,790	347.6	648	137.5	.057	67.2	.193
9	Min. 24-Hr (Annual)	3	81.2	8,110	150.1	288	61.1	.057	29.8	.198
10	Min. 3-Hr (Annual)	3	72.7	7,260	134.4	264	56.0	.057	27.4	.204

Table 7. Estimates of Uncontrolled Particulate Emissions from Oil-Fired Boilers

Mode of Operations	Operating Conditions	Number of Boilers Operating (No)	Percent Load for Ea Boilers (%)	Combined Boiler Fuel Rate (Lbs/Hr)	Combined Boiler Heat Input (10^6 Btu/Hr)	Combined Boiler Flue Gas Flow Rate (10^3 Lbs/Hr)		Particulate Emissions Concentration (Grains/scf)	Particulate Emissions Rate (Lbs/Hr)	Particulate Emissions Factor Lbs/(10^6) Btu
						(10^3 Lbs/Hr)	10^3 SCF/M			
1	Fall Season (Average)	0	---	---	---	---	---	.046	---	---
2	Winter Season (Average)	2	63.0	16,400	303.4	250.	59.4	.046	23.4	.077
3	Spring Season (Average)	1	53.3	6,800	125.8	117	24.8	.046	9.8	.078
4	Summer Season (Average)	0	---	---	---	---	---	.046	---	---
5	Max. 24-Hr (Winter)	3	77.0	30,300	560.6	515	109.3	.046	43.1	.077
6	Max. 3-Hr (Winter)	3	87.2	34,500	638.2	585	124.2	.046	49.0	.077
7	Max. 24-Hr (Summer)	0	---	---	---	---	---	.046	---	---
8	Max. 3-Hr (Summer)	1	27.2	2,700	50.0	49	10.4	.046	4.1	.082
9	Min. 24-Hr (Annual)	0	---	---	---	---	---	.046	---	---
10	Min. 3-Hr (Annual)	0	---	---	---	---	---	.046	---	---

Table 8. Estimates of Uncontrolled Particulate Emissions from Incinerators

Mode of Operations	Operating Conditions	Number of Incinerator Operating	Percent Load for Each Inc.	Hospital Waste	Fuel Oil Rate	Combined Heat Input	Combined Incinerator Flue Gas Flow Rate		Particulate Emissions		
									Concentrations	Rate	Factor
		(No)	(%)	(Tons/Hr)	(Lbs/Hr)	(10^6 Btu/Hr)	(10^3)Lbs/Hr	(10^3)SCF/M	Grains/scf	(Lbs/Hr)	(Lbs/10^6Btu)
1	Fall Season (Average)	1	100	1.0	324	18.0	20	4.2	0.76	27.4	1.502
2	Winter Season (Average)	1	100	1.0	324	18.0	20	4.2	0.76	27.4	1.502
3	Spring Season (Average)	1	100	1.0	324	18.0	20	4.2	0.76	27.4	1.502
4	Summer Season (Average)	1	100	1.0	324	18.0	20	4.2	0.76	27.4	1,502
5	Max. 24-Hr (Winter)	2	62	1.25	405	22.5	25	5.3	0.76	34.5	1,534
6	Max. 3-Hr (Winter)	2	62	1.25	405	22.5	25	5.3	0.76	34.5	1,534
7	Max. 24-Hr (Summer)	2	62	1.25	405	22.5	25	5.3	0.76	34.5	1.534
8	Max. 3-Hr (Summer)	2	62	1.25	405	22.5	25	5.3	0.76	34.5	1.534
9	Min. 24-Hr (Annual)	2	62	1.25	405	22.5	25	5.3	0.76	34.5	1.534
10	Min. 3-Hr (Annual)	2	62	1.25	405	22.5	25	5.3	0.76	34.5	1.534

Table 9. Estimates of Uncontrolled Particulate Emissions from Total Plant

Mode of Operations	Operating Conditions	Fuel Rate	Heat Input	Flue Gas Flow Rate		Particulate Emissions		
						Concentration	Rate	Factor
		(10^3)Lbs/Hr	(10^6)Btu/Hr	(10^3)Lbs/Hr	(10^3)SCF/M	Grains/scf	Lbs/Hr	Lbs/(10^6)Btu
1	Fall Season (Average)	10,800	212	404	85.8	.094	68.9	.325
2	Winter Season (Average)	22,500	429	509	108.1	.080	73.7	.172
3	Spring Season (Average)	15,200	293	429	91.1	.089	69.2	.236
4	Summer Season (Average)	14,600	282	526	111.7	.085	81.5	.289
5	Max. 24-Hr (Winter)	34,400	652	665	141.2	.076	92.6	.142
6	Max. 3-Hr (Winter)	41,100	776	804	170.7	.072	105.7	.136
7	Max. 24-Hr (Summer)	16,000	310	540	114.6	.092	90.0	.290
8	Max. 3-Hr (Summer)	21,900	420	702	149.0	.083	105.8	.252
9	Min. 24-Hr (Annual)	NA	172	313	66.4	.113	64.3	.374
10	Min. 3-Hr (Annual)	NA	156	289	61.3	.118	61.9	.397

Table 10. Estimated Particle Size Efficiency of Selected Particulate Control Devices

[illegible]E SIZE	HIGH EFFIC. CYCLONE	HIGH EFFIC. SCRUBBER	LOW EFFIC. ELECTR. PREC.	MEDIUM EFFIC. ELECTR. PREC.	HIGH EFFIC. ELECTR. PREC.	[illegible]
[illegible]01	0	0	5	34	87	95
[illegible]02	0	.2	7	39	91	95
[illegible]04	0	1	13	46	92	95
[illegible]06	.1	4	18	54	93	95
[illegible]08	.3	7	23	58	94	95
[illegible]1	.4	11	27	62	94.5	95
[illegible]2	1.3	21	34	66	95.6	[illegible]
[illegible]4	4.5	47	48	74	96.7	[illegible]
[illegible]6	10	67	58	79	97.5	[illegible]
[illegible]8	17	74	64	82	98.0	[illegible]
[illegible]	22	83	68	83	98.0	[illegible]
[illegible]	34	91	75	87	98.0	[illegible]
[illegible]	56	98	84	91	98.0	[illegible]
[illegible]	73	99.6	89	93	98.0	100
[illegible]	80	99.8	93	94.5	98.2	100
[illegible]10	84	99.9	97	96	98.4	100
[illegible]20	91	100	96	97	99.0	100
[illegible]40	96	100	97.5	99	99.6	100
[illegible]60	98.5	100	98.5	99	99.9	100
	99.4	100	99	99	100	100

Table 11. Estimated Weight Collection Efficiencies for Selected Particulate Control Devices

COMBUSTION EQUIPMENT/ CONTROL DEVICE	DIESEL ENGINE	STEAM BOILER	INCINERATOR
High Efficiency Cyclone	0-4	2-62	42-85
High Efficiency Scrubber	1-34	17-94	80-97
Low Efficiency Precipitator	12-40	25-85	73-93
Medium Efficiency Precipitator	45-69	56-91	86-96
High Efficiency Precipitator	92-96	93-98	98-99.4
Fabric Filter	95-96	95-99.6	99.0-99.8

NOTE: The range of efficiency for the particle emissions control equipment is based on assumed inputs of Worst Case - Best Case expected particle size distribution for each combustion source.

Table 12. Estimated Outlet Concentrations After Selected Particulate Control Devices

Combustion Equipment / Uncontrolled concentration / Control Device	Diesel Engine (0.057)	Boiler Normal (0.046)	Boiler Soot Blow (0.144)	Incinerator (0.76)
High Effic. Cyclone	0.055-0.057	0.017-0.045	0.055-0.141	0.114-0.441
High Effic. Scrubber	0.038-0.056	0.003-0.037	0.009-0.120	0.023-0.152
Low Effic. Precip.	0.034-0.050	0.007-0.034	0.022-0.108	0.053-0.205
Medium Effic. Precip.	0.018-0.031	0.004-0.020	0.013-0.063	0.030-0.106
High Effic. Precip.	0.002-0.005	0.0009-0.003	0.003-0.010	0.005-0.015
Fabric Filter	0.002-0.003	0.0002-0.002	0.0006-0.007	0.002-0.008

Table 13. Estimates of Particulate Emissions from Diesel Engines Controlled with Afterburners

# of Operation	Operating Conditions	Diesel Flow Rate (10^3 Lbs/Hr)	Number of Afterburners Operating (No)	Percent Load for Ea Afterburner (%)	Combined Afterburner Fuel Rate (Lbs/Hr)	Combined Afterburner Heat Input (10^6 Btu/Hr)	Combined Diesel & Burner Heat Input (10^6 Btu/Hr)	Diesel Fuel Rate (Lbs/Hr)	Diesel Emission Rates (Lbs/Hr)			Percentage Destruction Of Particulates (%)	Emission Rates (Lbs/Hr)		Total Flue Gas Flow Rate		Particulate Emissions	
									Total Particulates	Ash Portion	Total W/O Ash		Total W/O Ash	Total	(10^3) Lbs/Hr	(10^3) SCFM	Concentration grains/scf	Factor Lbs/10^6 Btu
1	Fall Season (Average)	400	1	86.2	5,200	96.2	290.6	10,510	41.5	5.25	36.2	90	3.62	8.87	432	91.7	.012	.030
2	Winter Season (Average)	225	1	48.5	2,900	53.6	161.4	5,830	23.4	2.92	20.5	90	2.05	4.97	240	50.9	.011	.031
3	Spring Season (Average)	308	1	66.6	4,000	74.0	223.4	8,070	32.0	4.04	28.0	90	2.80	6.84	333	70.7	.011	.031
4	Summer Season (Average)	522	2	56.2	6,800	125.8	389.8	14,270	54.1	7.14	47.0	90	4.70	11.84	560	118.9	.012	.030
5	Max. 24-Hr (Winter)	145	1	31.2	1,800	33.3	102.1	3,720	15.0	1.86	13.1	90	1.31	3.17	153	32.5	.011	.031
6	Max. 3-Hr (Winter)	214	1	46.1	2,750	50.9	165.9	6,220	27.2	3.11	19.1	90	1.91	5.02	229	48.6	.012	.030
7	Max. 24-Hr (Summer)	533	2	57.6	7,000	129.5	417.2	15,550	55.5	7.78	47.7	90	4.77	12.55	576	122.3	.012	.030
8	Max 3-Hr (Summer)	648	2	69.8	8,400	155.4	503.0	18,790	67.2	9.40	57.8	90	5.78	15.18	700	146.6	.012	.030
9	Min. 24-Hr (Annual)	288	1	62.1	3,700	68.4	218.5	8,110	29.8	4.06	25.7	90	2.57	6.63	310	65.8	.012	.030
10	Min 3-Hr (Annual)	264	1	56.9	3,450	63.8	198.2	7,260	27.4	3.63	23.8	90	2.38	6.01	284	60.7	.012	.030

Table 14. Estimates of Particulate Emissions from Oil-Fired Boilers Controlled with Electrostatic Precipitators

Mode of Operations	Operating Conditions	Inlet Conditions: Heat	Inlet Conditions: Flue Gas Rate		Inlet Conditions: Emissions	Collector Efficiency: Best Case	Collector Efficiency: Worst Case	Outlet Particulate Emissions: Concentration (Grains/scf)			Outlet Particulate Emissions: Rate	Outlet Particulate Emissions: Factor
		(10^6)Btu/Hr	(10^3)#/Hr	(10^3)SCF/M	Concentrations (Grains/scf)	(%)	(%)	Min	Max	Avg	Lbs/hr	Lbs/10^6Btu
1	Fall Season (Average)	-----	---	-----	.046	91.4	56.2	.004	.020	.012	----	----
2	Winter Season (Average)	303.4	280	59.4	.046	91.4	56.2	.004	.020	.012	6.11	.020
3	Spring Season (Average)	125.8	117	24.8	.046	91.4	56.2	.004	.020	.012	2.55	.020
4	Summer Season (Average)	-----	---	-----	.046	91.4	56.2	.004	.020	.012	----	----
5	Max. 24-Hr (Winter)	560.6	515	109.3	.046	91.4	56.2	.004	.020	.012	11.2[illegible]	.020
6	Max. 3-Hr (Winter)	638.2	585	124.2	.046	91.4	56.2	.004	.020	.012	12.76	.020
7	Max. 24-Hr (Summer)	-----	---	-----	.046	91.4	56.2	.004	.020	.012	----	----
8	Max. 3-Hr (Summer)	50.0	49	10.4	.046	91.4	56.2	.004	.020	.012	1.07	.021
9	Min. 24-Hr (Annual)	-----	---	-----	.046	91.4	56.2	.004	.020	.012	----	----
10	Min. 3-Hr (Annual)	-----	---	-----	.046	91.4	56.2	.004	.020	.012	----	----

Table 15. Estimates of Particulate Emissions from Incinerators with Controlled Air Combustion Afterburners

Mode of Operations	Operating Conditions	Inlet Conditions: Heat	Inlet Conditions: Flue Gas Flow Rate		Inlet Conditions: Emission Concentrations	Collector Efficiency**: Best Case	Collector Efficiency**: Worst Case	Outlet Particulate Emissions: Concentrations (Grains/scf)			Outlet Particulate Emissions: Rate	Outlet Particulate Emissions: Factor
		(10^6)Btu/Hr	(10^3)Lbs/Hr	(10^3)SCF/M	(Grains/scf)	(%)	(%)	Min	Max	Avg.	Lbs Hr	Lbs/10^6Btu
1	Fall Season (Average)	18.0	20	4.2	0.76				0.10		3.6	.200
2	Winter Season (Average)	18.0	20	4.2	0.76				0.10		3.6	.200
3	Spring Season (Average)	18.0	20	4.2	0.76				0.10		3.6	.200
4	Summer Season (Average)	18.0	20	4.2	0.76				0.10		3.6	.200
5	Max. 24-Hr (Winter)	22.5	25	5.3	0.76				0.10		4.5	.200
6	Max. 3-Hr (Winter)	22.5	25	5.3	0.76				0.10		4.5	.200
7	Max. 24-Hr (Summer)	22.5	25	5.3	0.76				0.10		4.5	.200
8	Max. 3-Hr (Summer)	22.5	25	5.3	0.76				0.10		4.5	.200
9	Min. 24-Hr (Annual)	22.5	25	5.3	0.76				0.10		4.5	.200
10	Min. 3-Hr (Annual)	22.5	25	5.3	0.76				0.10		4.5	.200

*Assumed that the control equipment will at least equal the standard.
**To be determined later.

Table 16. Estimates of Controlled Particulate Emissions from Total Plant

Mode of Operations	Operating Conditions	Heat Input (10^6)Btu/Hr	Flue Gas Flow Rate (10^3)#/Hr	(10^3)SCF/M	Total Facility Particulate Emissions Concentration Grains/scf	Rate #/Hr	Factor* #/10^6Btu	Factor (oil)** #/10^6 Btu
1	Fall Season (Average)	308.6	452	95.9	.015	12.5	.040	.030
2	Winter Season (Average)	482.8	540	114.6	.015	14.7	.030	.024
3	Spring Season (Average)	367.2	470	99.8	.015	13.0	.035	.027
4	Summer Season (Average)	407.8	580	123.1	.015	15.4	.038	.030
5	Max. 24-Hr (Winter)	685.2	693	147.1	.015	18.9	.028	.022
6	Max. 3-Hr (Winter)	826.6	839	178.1	.015	22.3	.027	.022
7	Max. 24-Hr (Summer)	439.7	601	127.6	.016	17.1	.039	.030
8	Max. 3-Hr (Summer)	575.5	774	164.3	.015	20.7	.036	.029
9	Min. 24-Hr (Annual)	241.0	335	71.1	.018	11.1	.046	.030
10	Min. 3-Hr (Annual)	220.7	311	66.0	.018	10.5	.048	.030
Existing Plant (For Comparison)		373.1	606	128.7	.021	22.8	.061	.061

*Based on particulate concentration (including incinerator emissions) and on fuel use (including refuse heating value); should not be compared against fossil fuel utilization standard of 0.05 lbs/10^6 Btu.

**Based on fossil fuel emissions and use only; for comparison with standard.

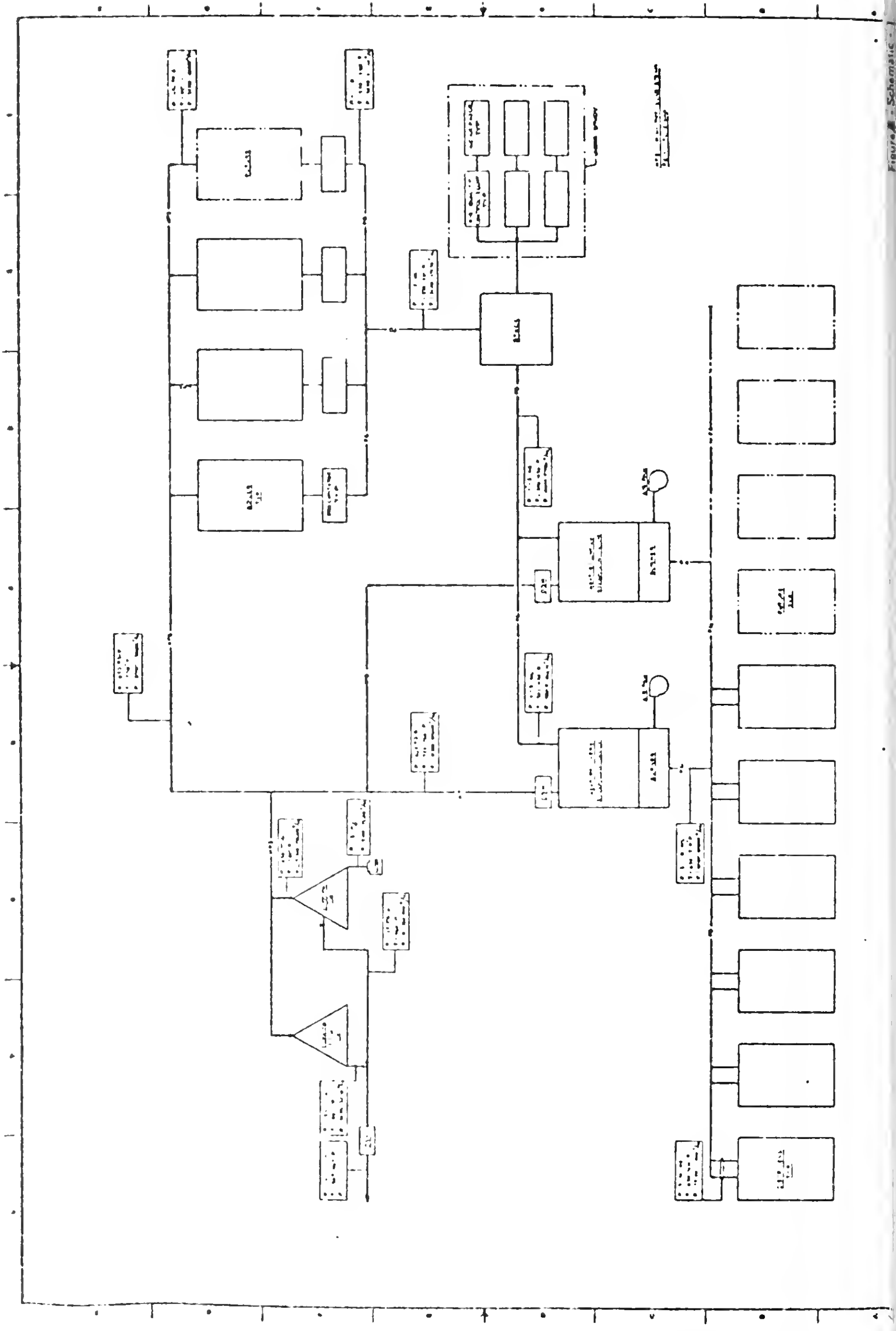


Figure - Schematic - 1

The appendices referenced within Appendix G are available upon request.

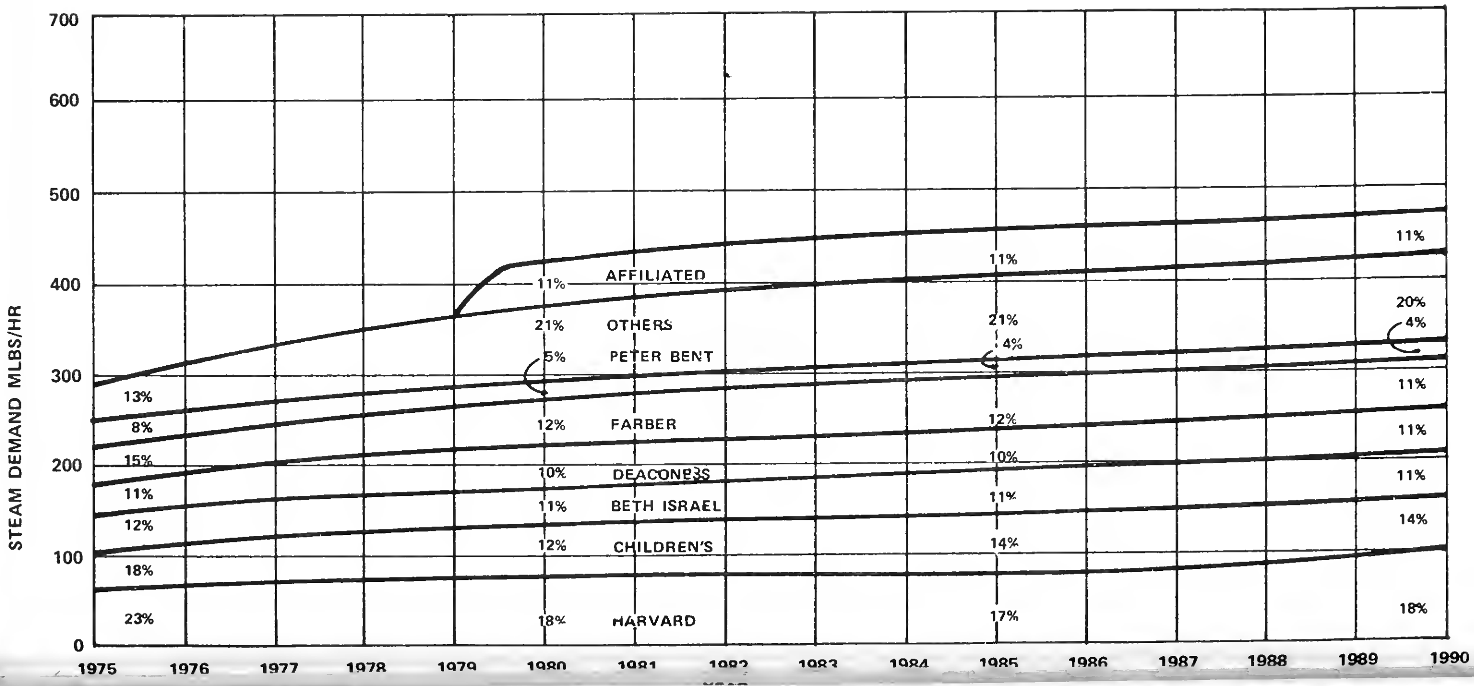
APPENDIX H

Utility Demand Summary

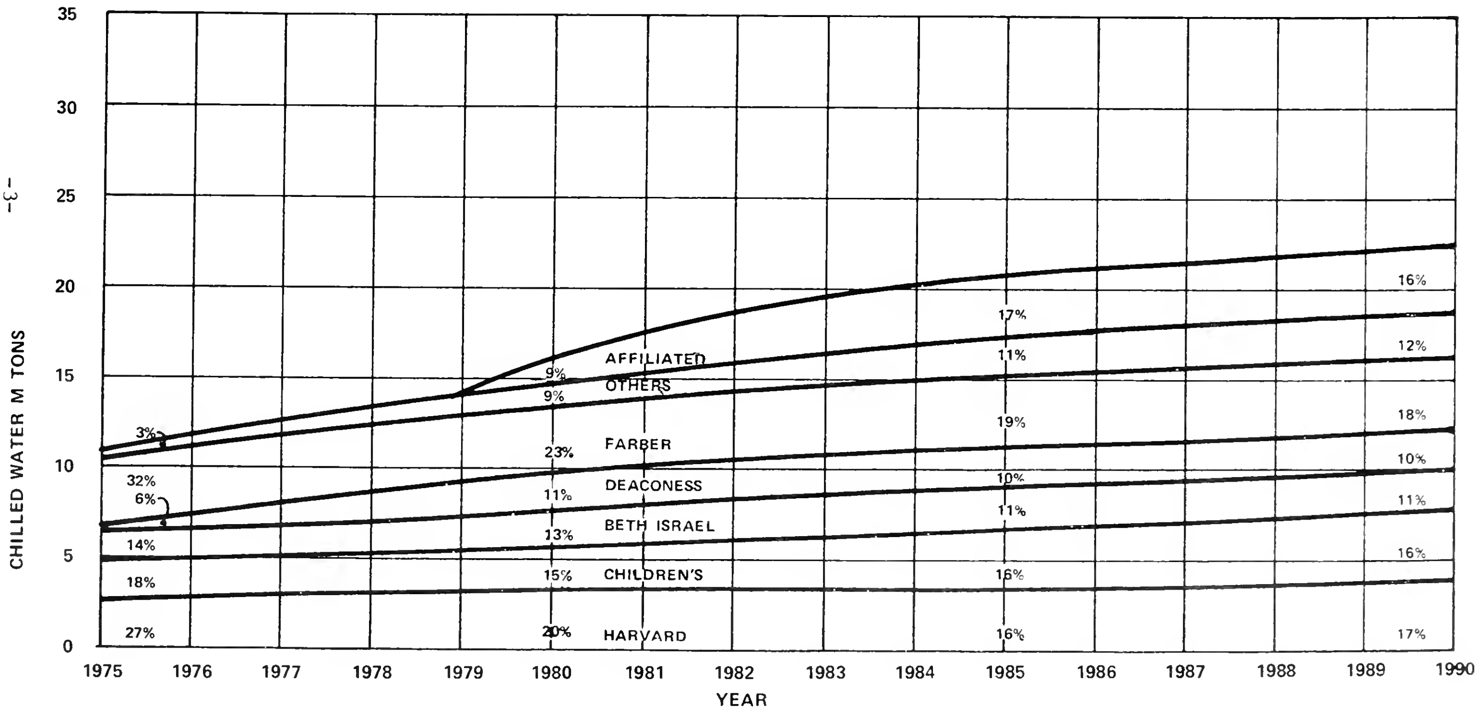
	Steam, 1000 lbs/hr.				Chilled Water, tons				Electric, kW			
	Base	1980	1985	1990	Base	1980	1985	1990	Base	1980	1985	1990
Affiliated Hospitals Center	-	39	50	50	-	2,800	3,590	3,590	-	3,900	5,000	5,000
Boston Hospital for Women	13	13	15	15	* 180	180	860	860	850	850	1,075	1,075
Peter Bent Brigham Hospital	22	20	20	18	-	-	-	-	2,100	1,900	[illegible]	2,350
Beth Israel Hospital	33	47	51	51	* 1,500	2,100	2,350	2,400	2,500	3,800	4,050	4,150
Children's Hospital Medical Center	51	53	62	64	1,920	2,380	3,335	3,615	4,800	5,040	6,000	6,440
Joslin Diabetes Foundation	4	15	17	20	80	700	770	930	375	1,100	1,300	1,600
Harvard University Medical Center	65	78	78	88	* 1,800 1,000	3,400	3,400	3,900	4,900	5,665	5,665	6,165
Massachusetts College of Pharmacy	5	5	5	5	-	135	200	300	300	500	600	750
Sidney Farber Cancer Center	44	49	51	53	3,360	3,700	3,950	4,150	2,764	3,280	3,730	4,150
Simmons College	* 15	20	20	20	-	-	-	-	-	-	-	-
New England Deaconess Hospital	31	42	47	52	630	1,800	2,000	2,150	2,300	3,000	3,000	3,450
Mission Park	-	25	25	25	-	-	-	-	-	-	-	-
MASCO Service Center	-	10	10	10	-	500	500	500	-	500	500	500
Massachusetts College of Art	2	2	2	2	-	-	-	-	-	-	-	-
TOTALS	285	419	453	473	10,470	17,695	20,955	22,395	20,899	29,400	33,410	35,360

*load not supplied by existing Harvard plant.

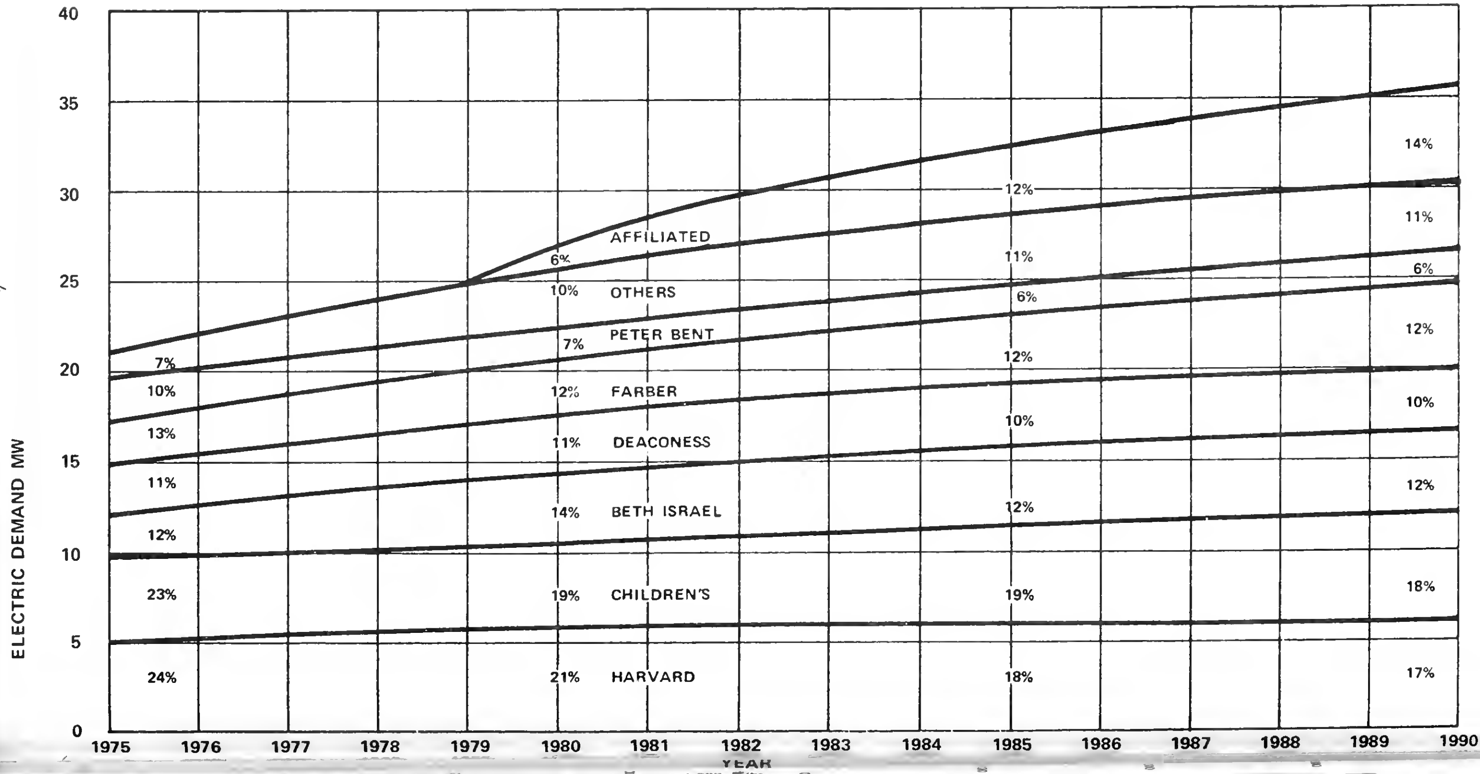
MEDICAL AREA TOTAL ENERGY PLANT
STEAM DEMAND PROJECTIONS



MEDICAL AREA TOTAL ENERGY PLANT
CHILLED WATER DEMAND PROJECTIONS



MEDICAL AREA TOTAL ENERGY PLANT
ELECTRICAL POWER DEMAND PROJECTIONS



DAILY LOAD PROFILE

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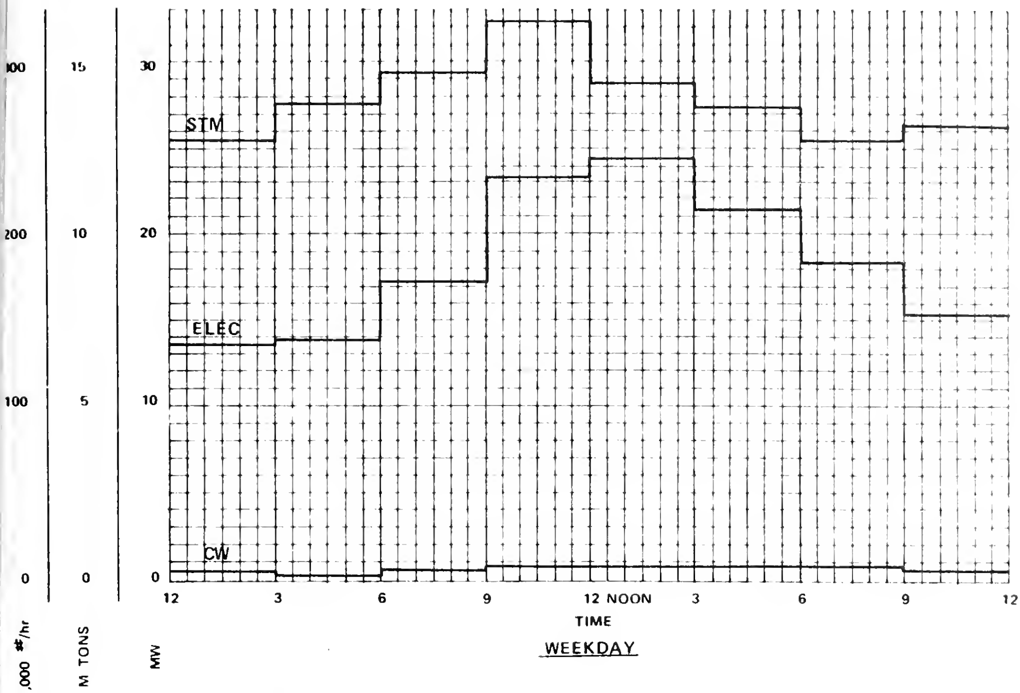

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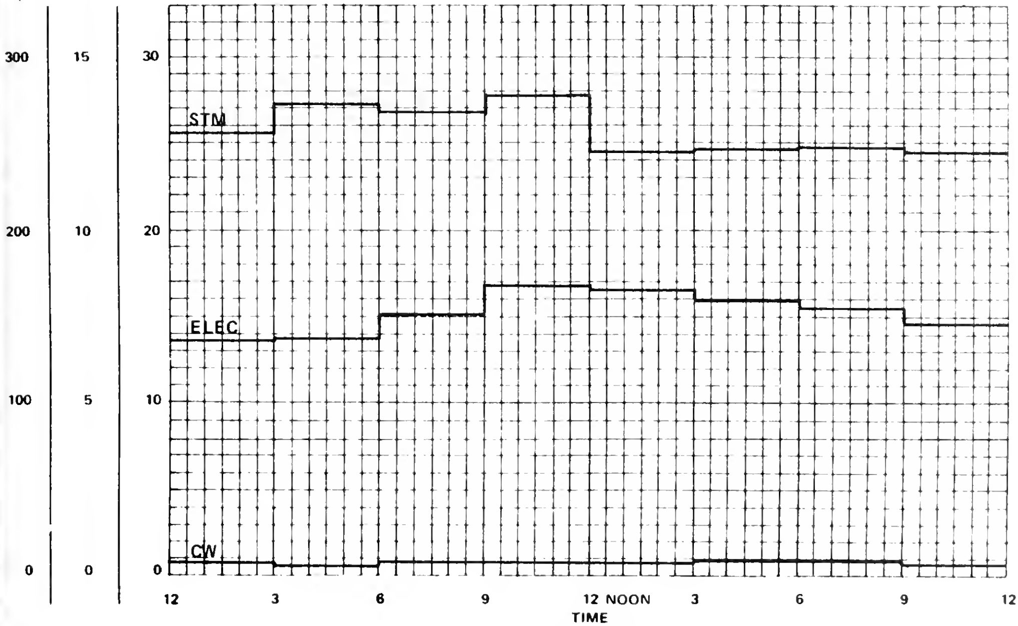

SAT/SUN/HOL

DAILY LOAD PROFILE

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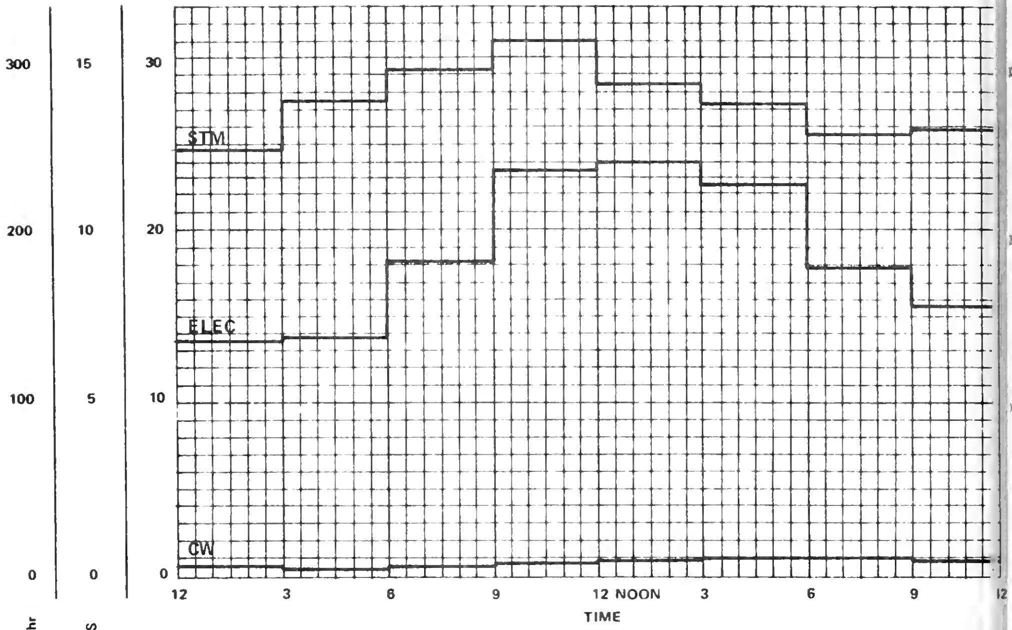

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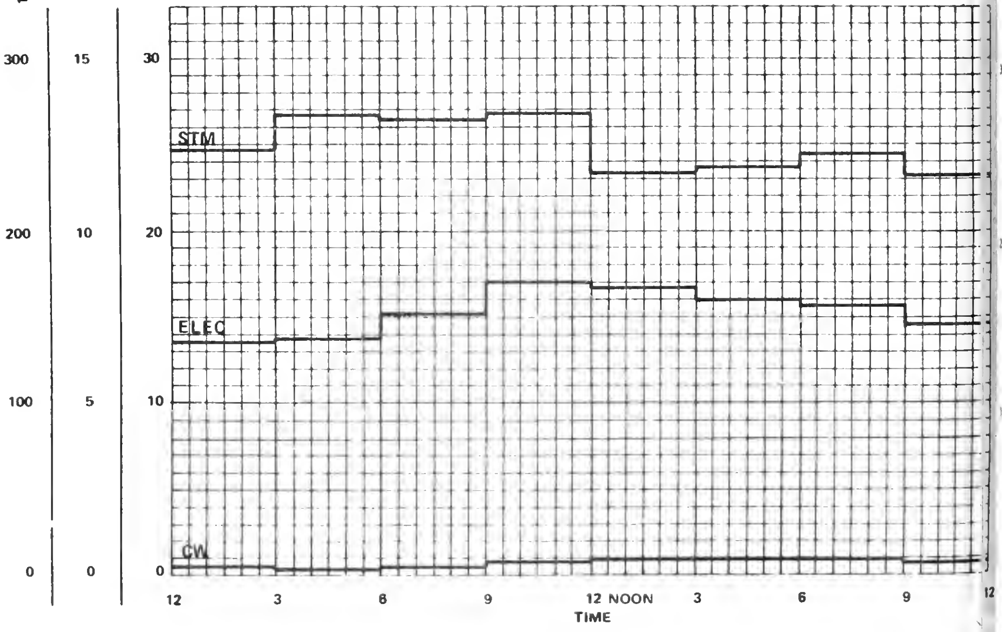

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DAILY LOAD PROFILE

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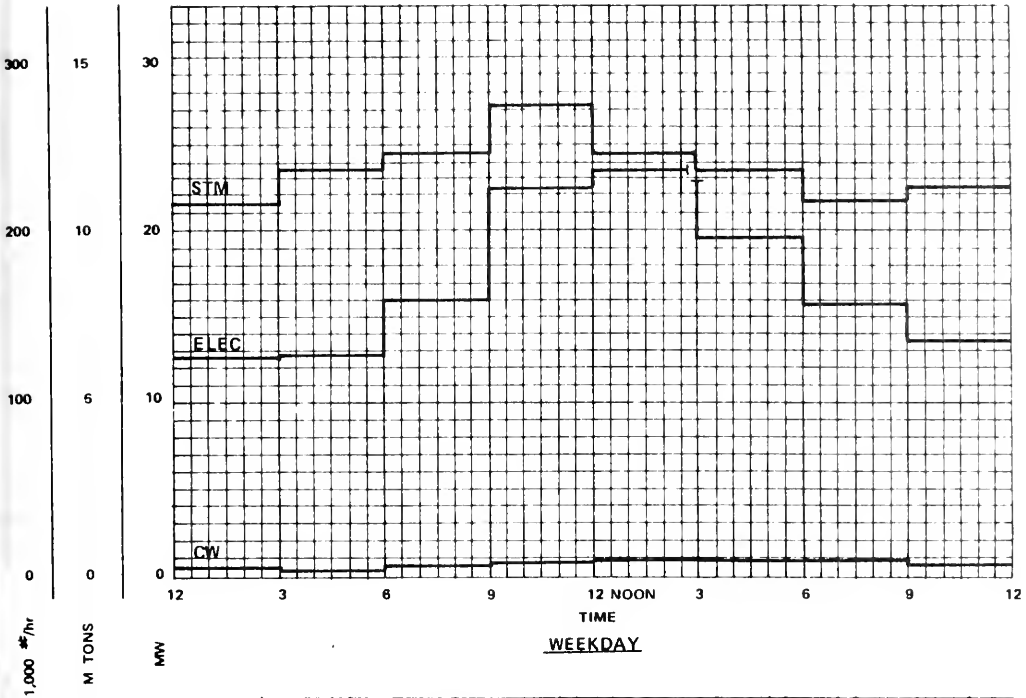

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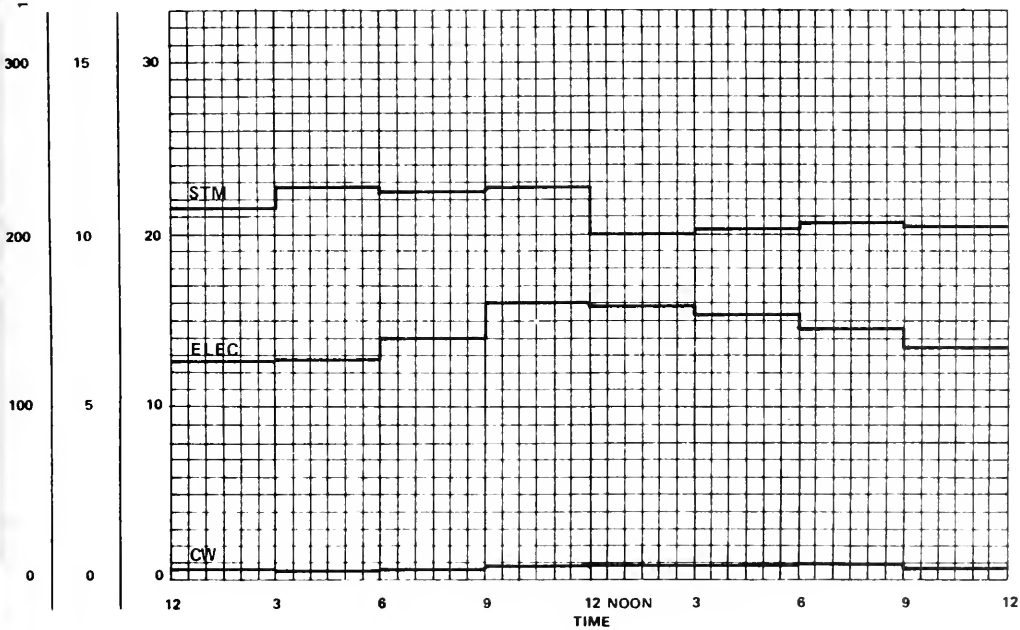

SAT/SUN/HOL

DAILY LOAD PROFILE

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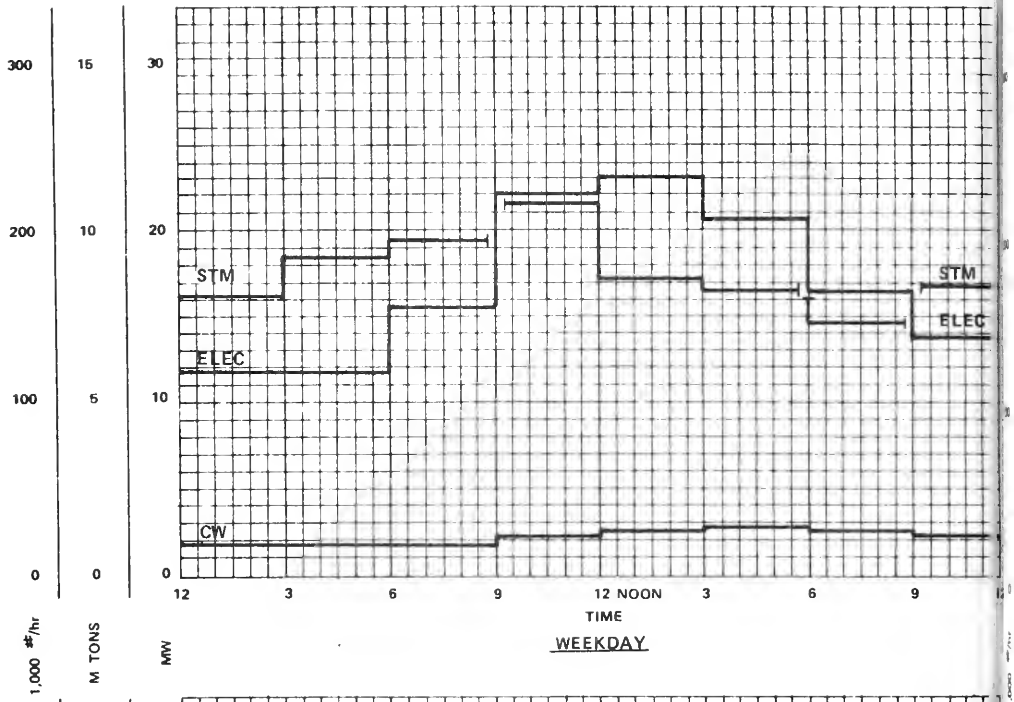

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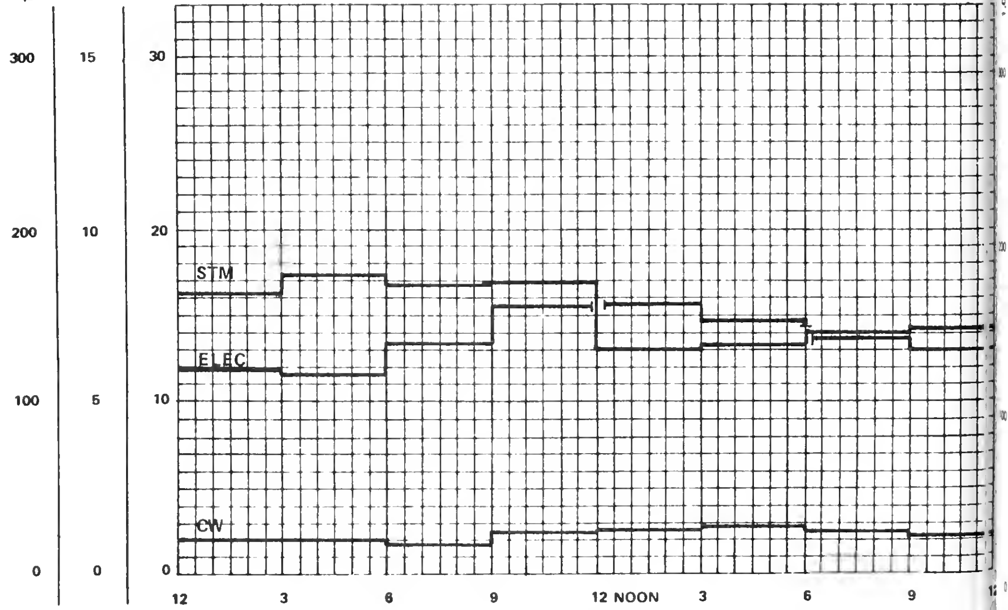

SAT/SUN/HOL

DAILY LOAD PROFILE

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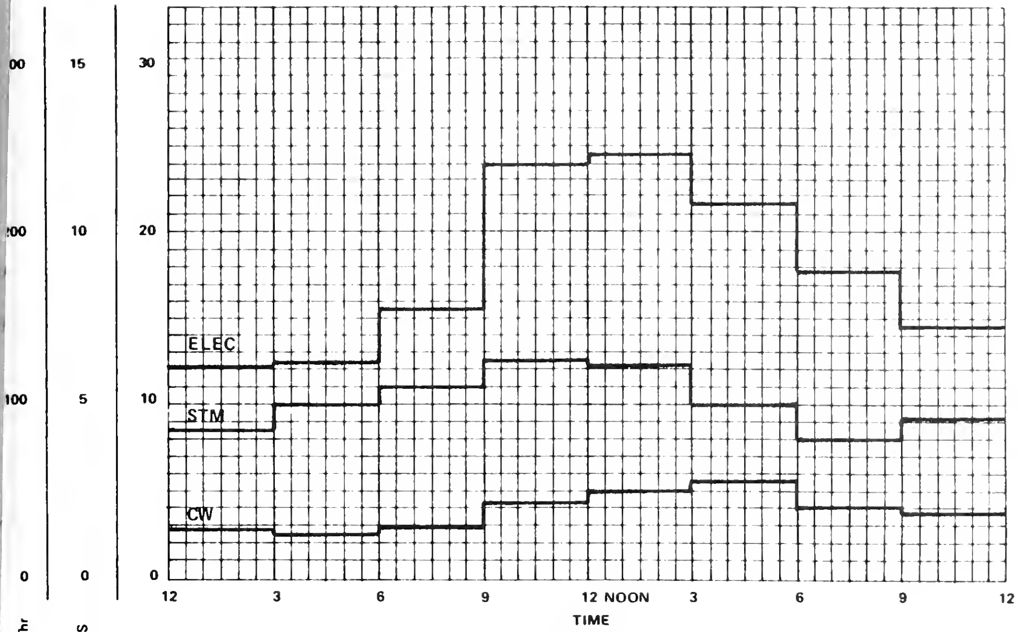

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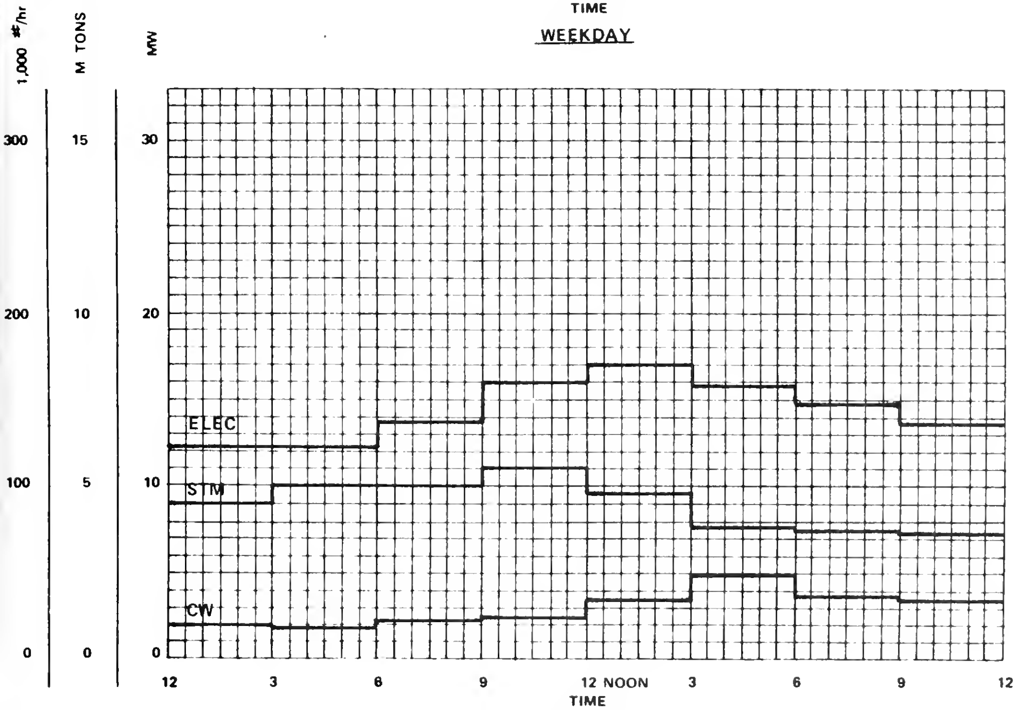

SAT/SUN/HOL

DAILY LOAD PROFILE

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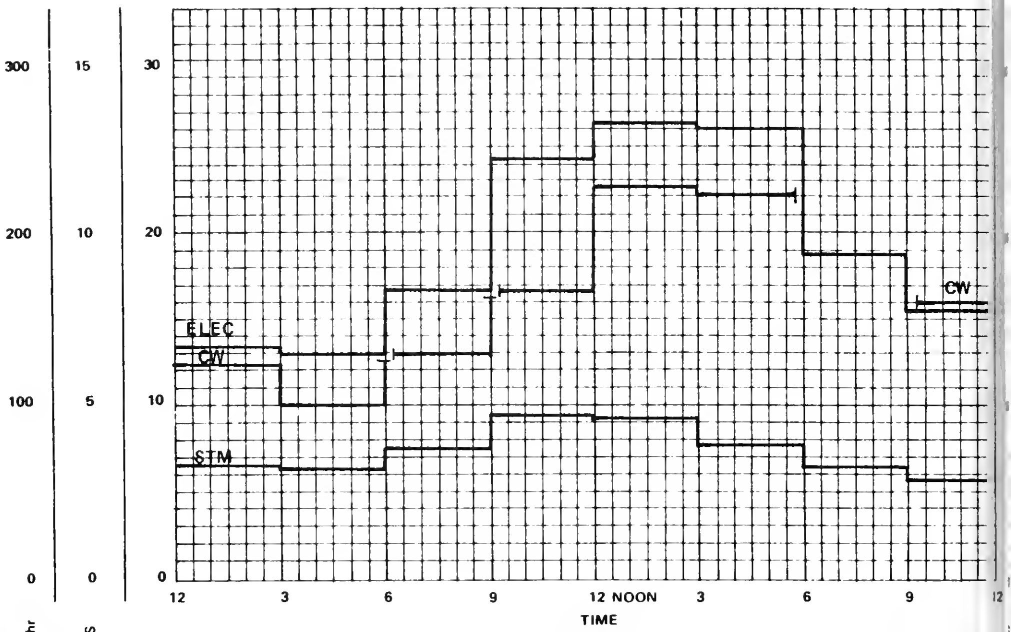

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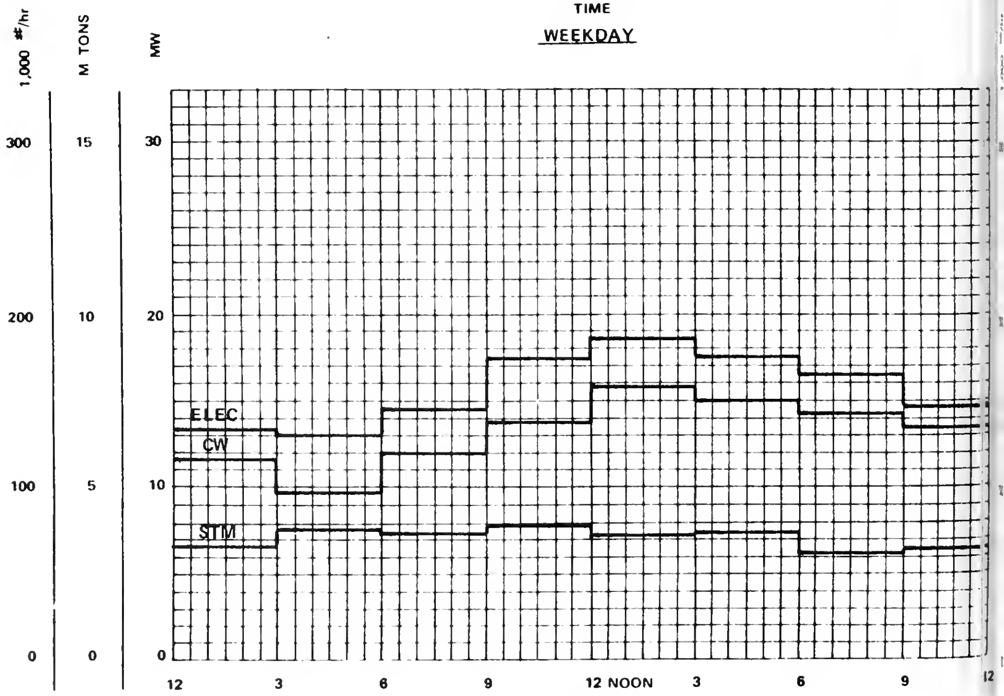

SAT/SUN/HOL

DAILY LOAD PROFILE

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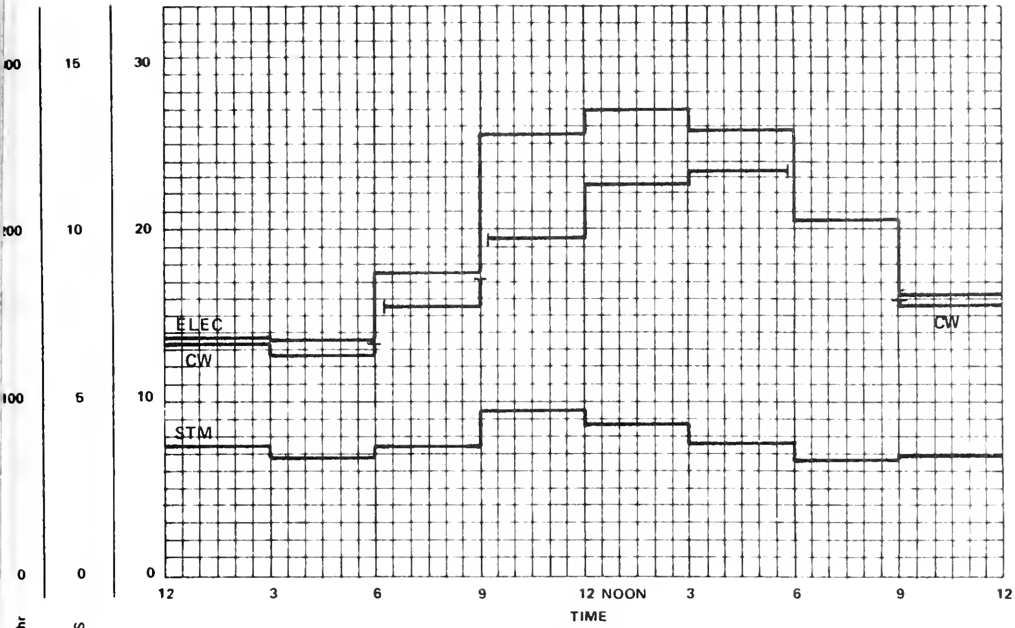

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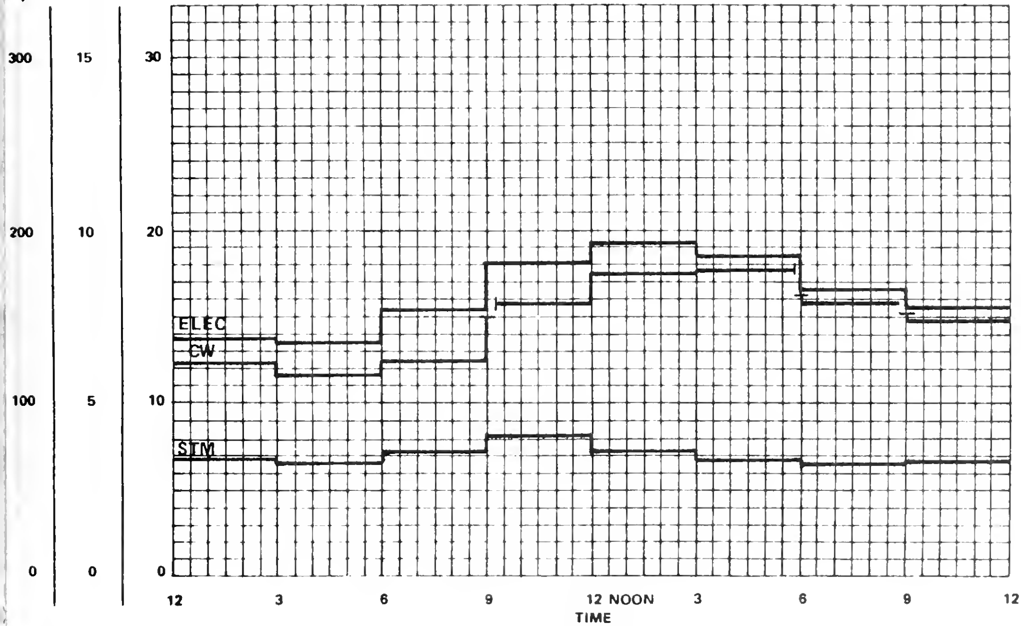

SAT/SUN/HOL

DAILY LOAD PROFILE

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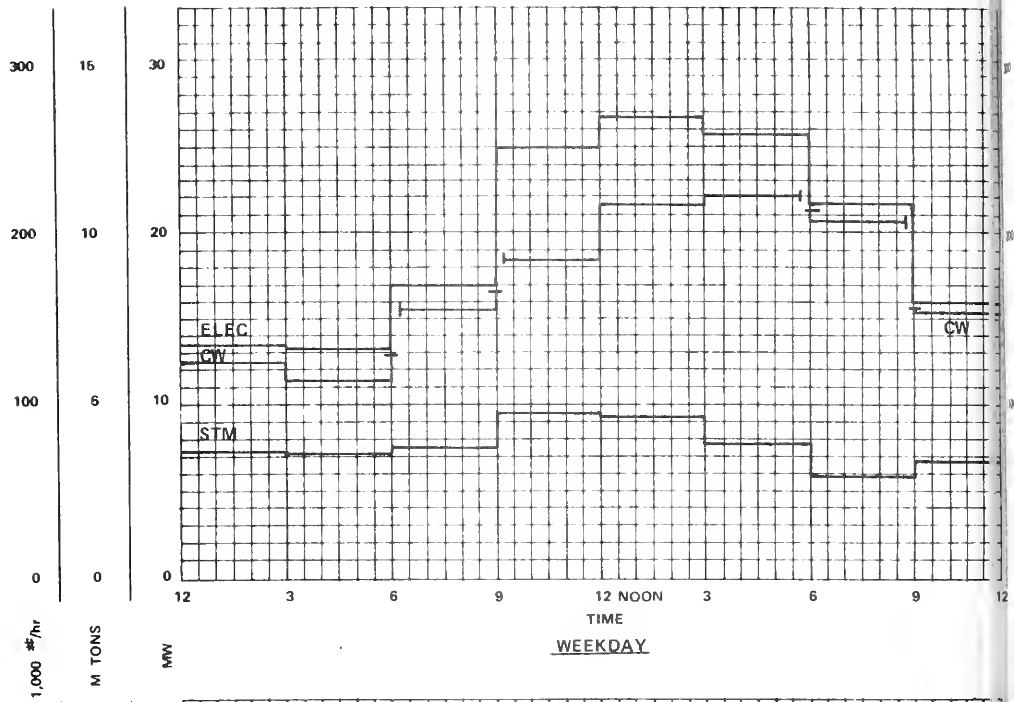

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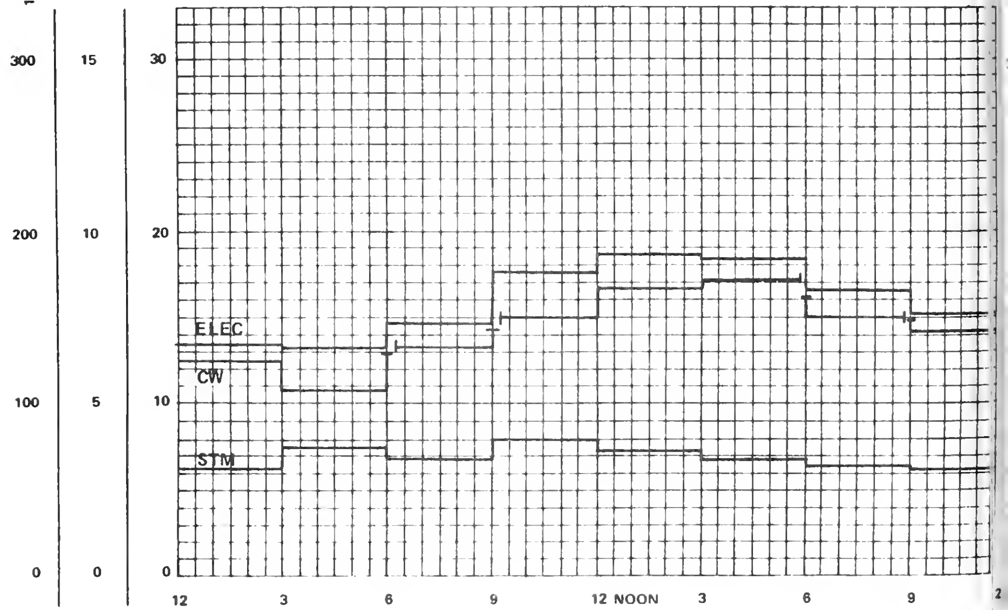

SAT/SUN/HOL

DAILY LOAD PROFILE

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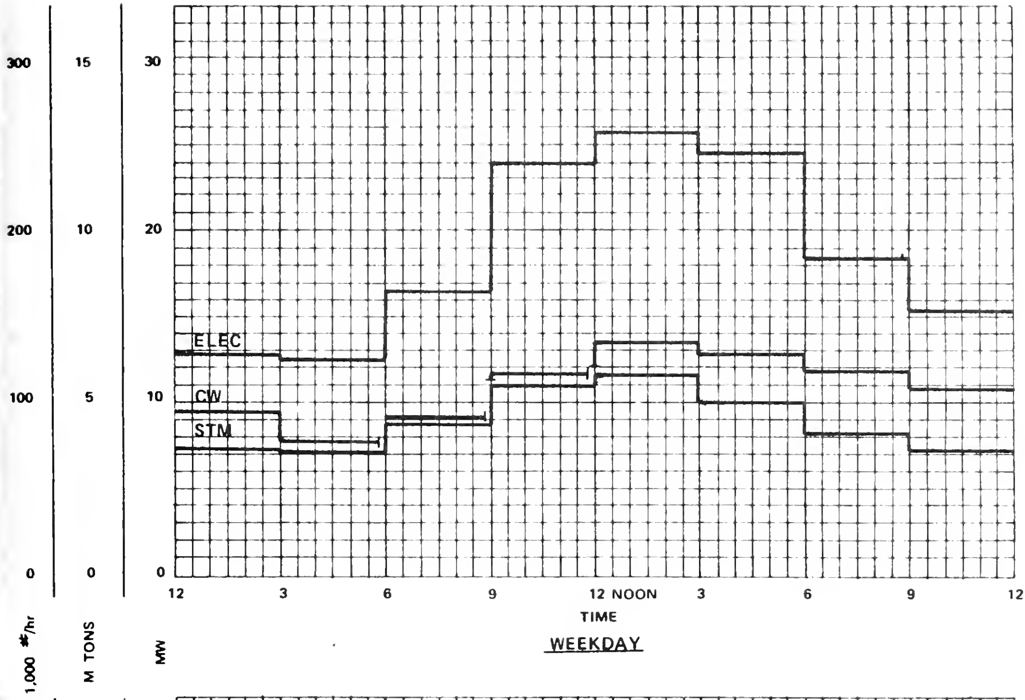

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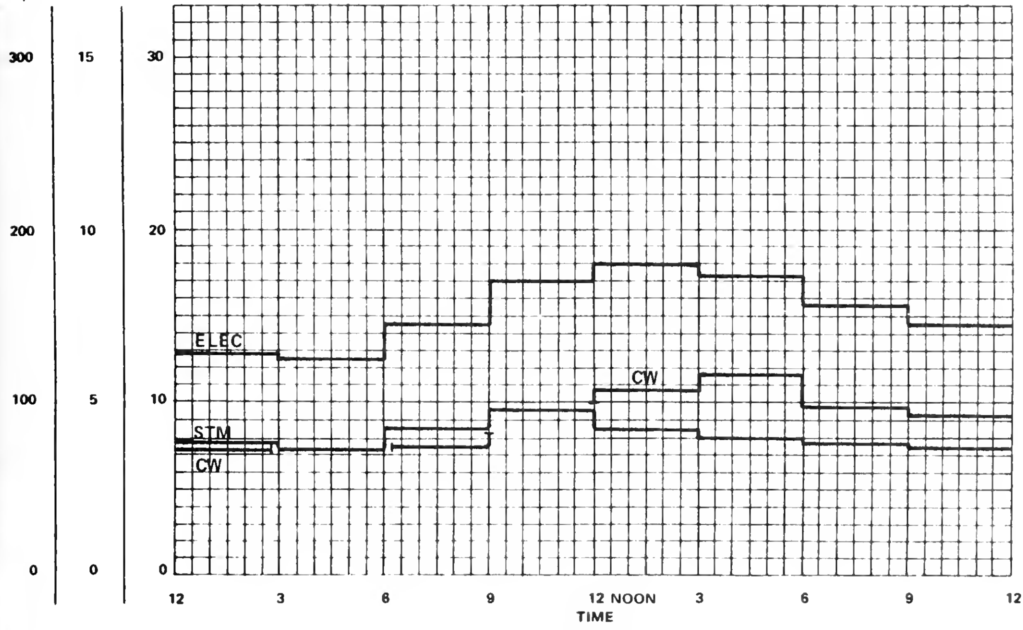

SAT/SUN/HOL

DAILY LOAD PROFILE

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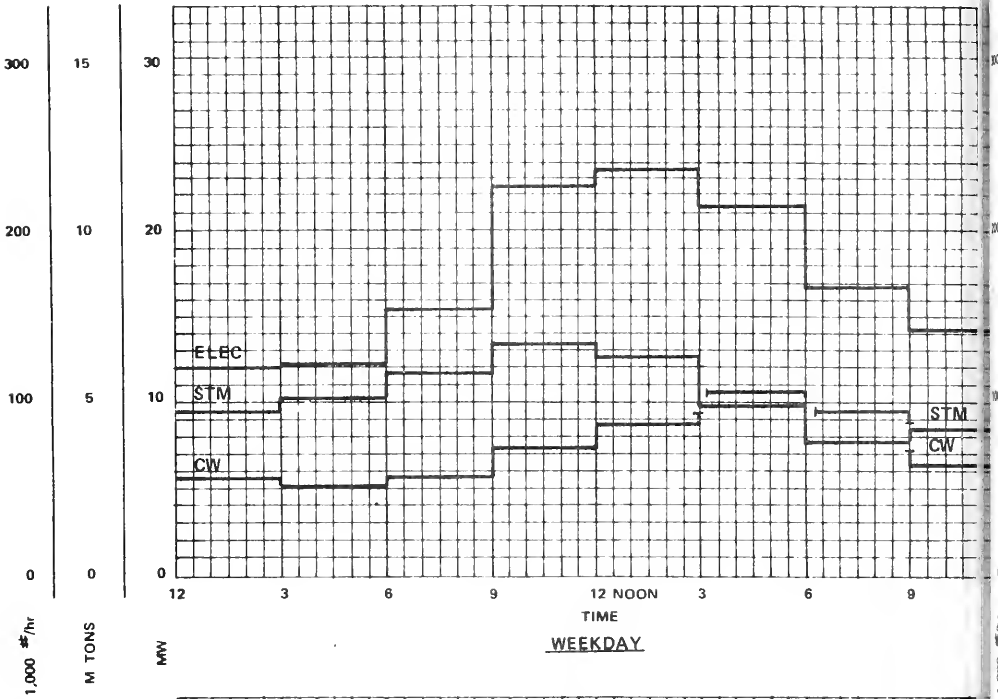

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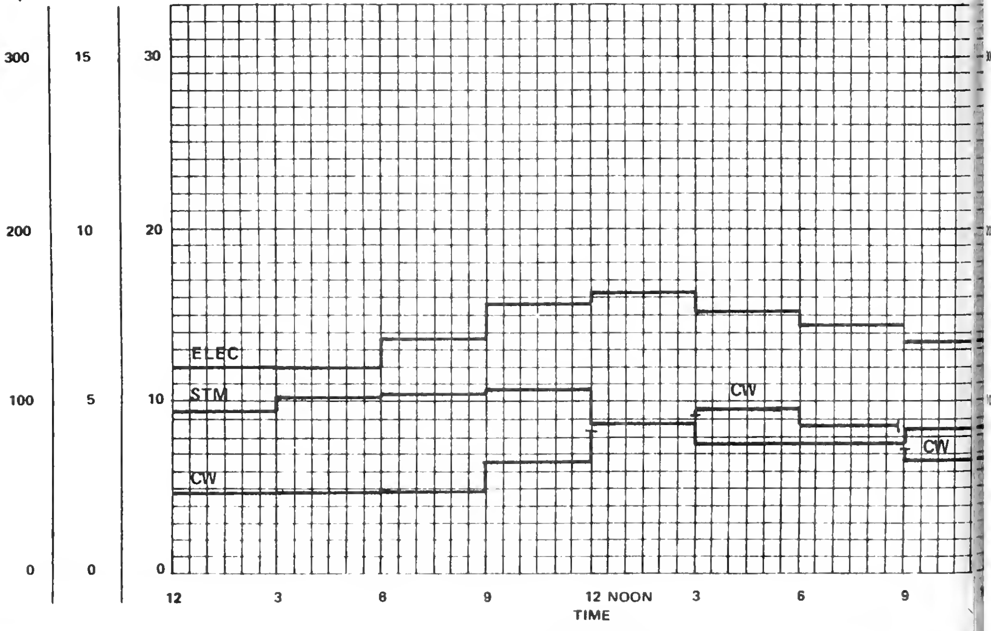

SAT/SUN/HOL

DAILY LOAD PROFILE

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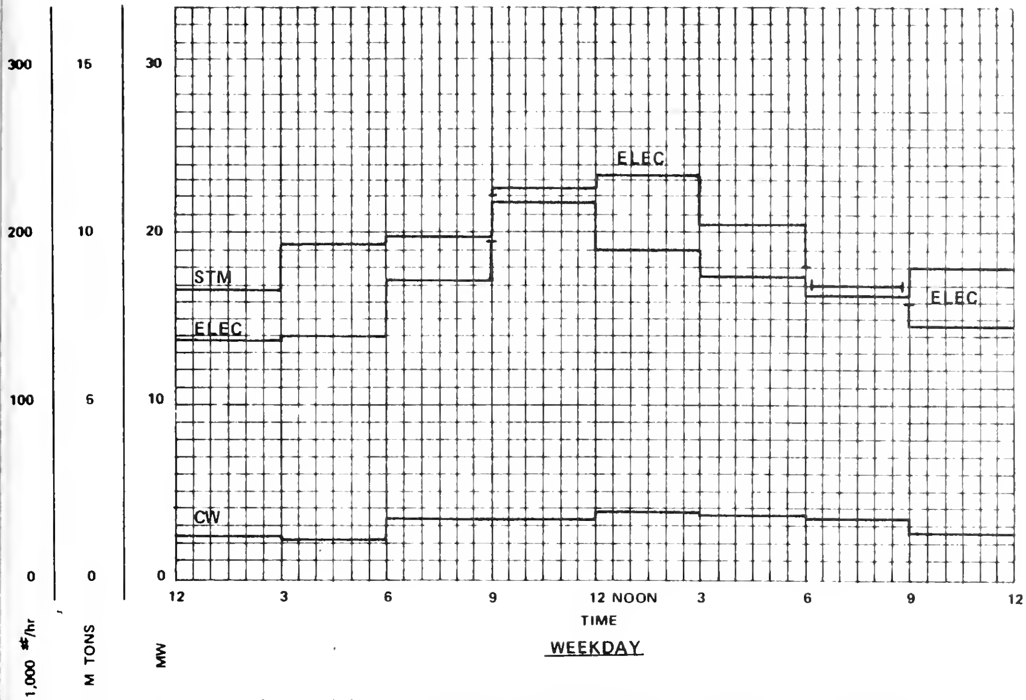

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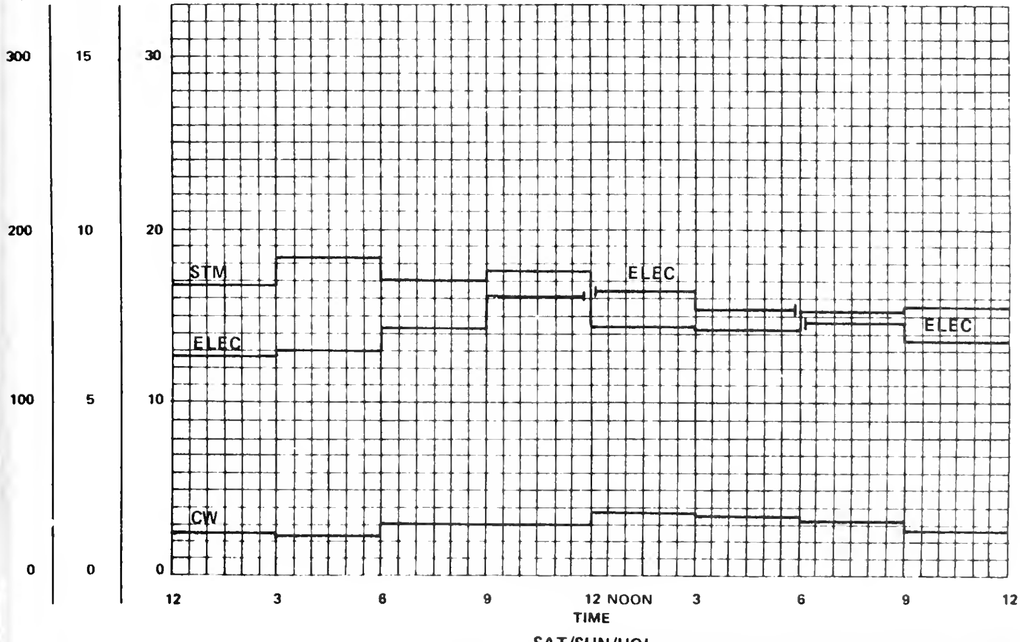

SAT/SUN/HOL

DAILY LOAD PROFILE

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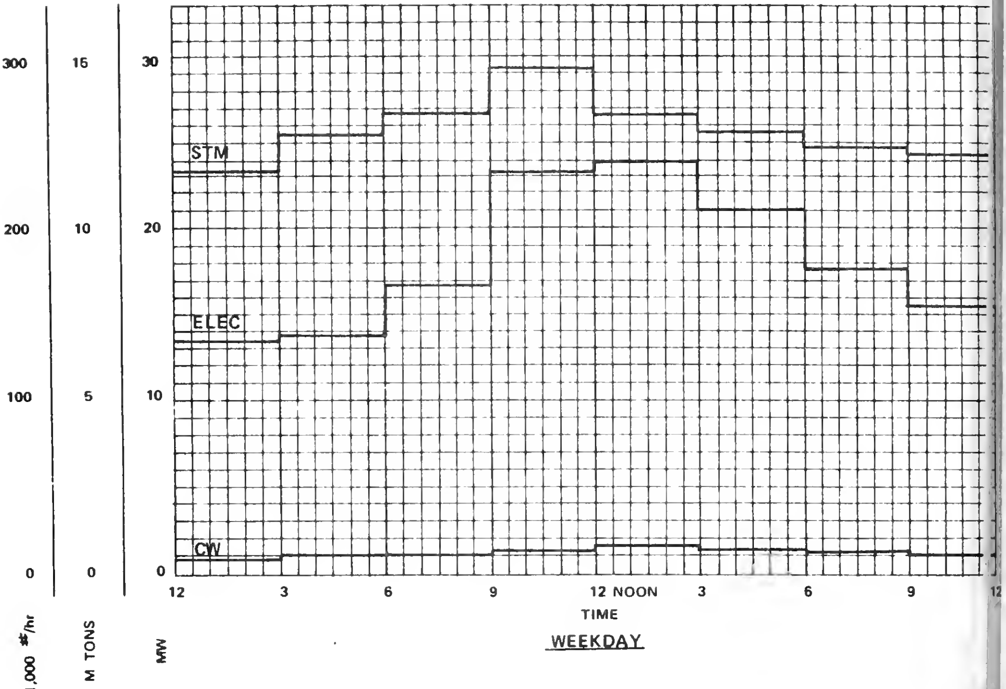

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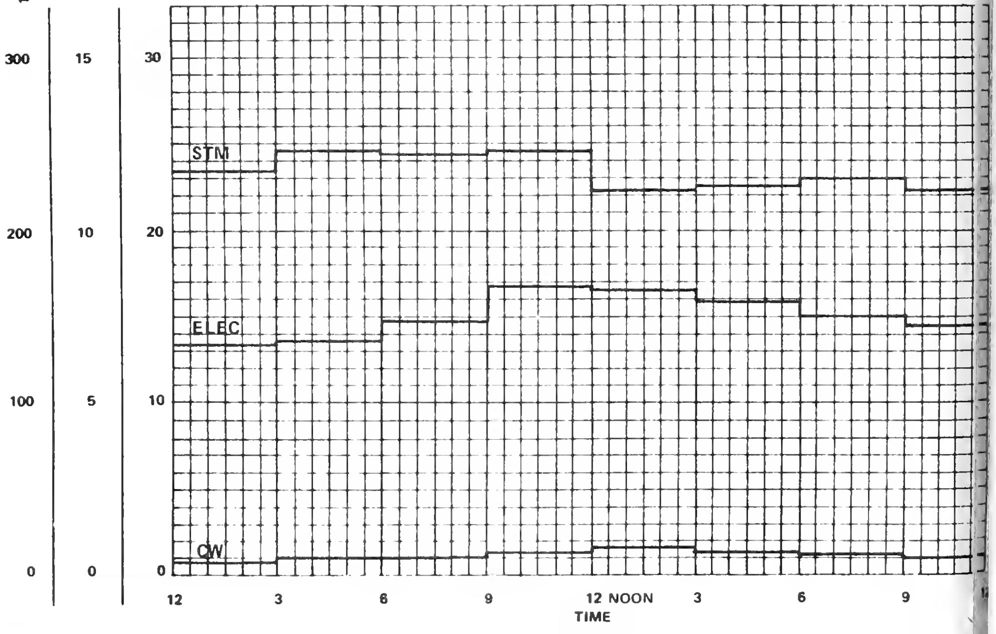

SAT/SUN/HOL

APPENDIX I

Halitsky Analysis of Cooling Tower

Height Increase

Response to Building Downwash Questions

Harvard MATEP Chimney Plume Analysis

Prepared by

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Aprol 30, 1977

Introduction

This report is a response to comments by the Brookline Selectmen's Ad Hoc Committee on the Harvard Energy Plant about the influence of nearby buildings on the MATEP stack plume. The Committee's comments were sent to the executive Office of Environmental Affairs in two letters from Daniel G. Partan dated March 7, 1977, and were forwarded to UEC on March 15, 1977 by Richard Mertens, Environmental Review Officer with a request for a written response on matters relating to the Air Quality Plans Approval Application. I have extracted from the Committee's comments three which relate to local downwash; they are reproduced in App. A. They will be referred to in the following discussion as Comment 1, Comment 2, and Comment 3.

Response

The concern of the Committee seems to be that the effect of building-induced disturbances of the wind stream may produce plume downwash which is not considered in the analysis submitted with the Approval Application, and that inclusion of such downwash would show significant increases in predicted concentrations at the surfaces of nearby buildings and at the local ground.

Comment 1 refers to ' "downwash" or high concentrations' produced by Bldgs. 1, 2, 4, and 5, each over 200 ft high. The wind disturbances generated by these buildings were analysed in my report "Analysis of Interactions Between Building Wakes and the Stack Plume of the Proposed Masco -Harvard Power Plant" dated March 9, 1975. After taking into consideration the wakes and cavities generated by these and other buildings, the following conclusions were reached:

1) The buildings at the base of the stack are too small to generate disturbances that would ascend to the region of the plume; therefore it would only be necessary to consider disturbances created by the four buildings.

2) When the wind is from the stack toward any of the buildings, concentrations at the building roof can be conservatively calculated by assuming a plume in a horizontal wind undisturbed by the building. The con servatism stems from the fact that the blocking effect of the building causes the plume to rise somewhat over the building, and inclusion of this effect would yield a lower predicted concentration at the roof. In the region just downwind of each building, the wake and, perhaps, the cavity created by the building would intersect the bottom of the plume under strong wind conditions, thereby accelerating downward dispersion of this portion of the plume. However, the intersected portion would contain only a small fraction of the total pollutant mass, and the volume of air between roof and ground is so large that the mixed concentration at the lee surfaces the building and at the ground would be much smaller than the concentration received by the roof receptor by direct impingement.

3) When the wind is from any tall building toward the stack, there is sufficient separation distance between building and stack for the flow t substantially recover its original undisturbed state by the time it reaches the stack. Any residual disturbance would continue to decay with distance downwind. Its effect would be to enhance initial plume spread, but it woul not be felt at the ground or at any nearby building roof.

I have reviewed my March 9, 1975 report in the light of test data from wind tunnel experiments that have come to my attention since 1975, and I find no indication that the above conclusions should be altered, if the topographical configuration is the same today as in 1975. Comment 2, however, indicates that the height of the power plant building has been increased, and this may affect conclusion 1).

Accordingly, I prepared Fig. 3 showing the local building sizes and shapes, using data on building heights provided by UEC, shown in Figs. a

Fig. 3a is a vertical section through a line from stack to Bldg. 2, looking westerly. This section was chosen because the highest roof concentrations occur at Bldgs. 2 and 4, and the wind direction toward Bldg. 2 contains the tallest upwind buildings. The solid lines in Fig. 3a are true sections of buildings cut by the vertical plane. The dashed lines are buildings that lie east or west of the section, but have been included to round out the picture. The only buildings of significance that lie in or near the section are the garage and the power plant, with the latter producing the stronger disturbance due to its greater height. Fig. 3b is a vertical projection in the wind direction. Again, the only significant building is the power plant, since the other buildings are too far upwind, downwind, or to the side to affect the wind flow between the stack and Bldg. 2.

Comment 2 indicates that the top of the cooling tower array is 152 ft above grade. This does not agree with information provided by UEC which places the top at el 177 ft or at a height of 140 ft above the local 37 ft grade. The building shown in Fig. 3 is drawn to scale with the UEC height. The increase of height from the original 98 ft is substantial, but it is not necessarily a cause for concern with respect to plume downwash.

Mention is made in Comment 2 that a stack/building height ratio of 2.5 is a regime of concern. I suggest that this statement is an erroneous interpretation of a common rule-of-thumb whose basis seems to have been forgotten. Correctly stated, the rule says that for an isolated structure on level ground, the trajectories of air parcels passing at elevations greater than 2.5 times the building height will not be influenced by the structure. The rule was devised by Dr. David Brunt of the British Meteorological Service when he was called upon to direct pollution control activities in England in the 1940's and 50's. It was based on his personal observations of buoyant ballons (PIBALS) passing over mountain ridges, during his service as a

weather observer in World War I. The rule was intended to be used as an indicator of potential building effect as the ratio decreased below 2.5.

There is no handbook to be used as a guide in determining when the condition of "no influence" at height ratios of 2.5 and greater becomes a "regime of concern" at ratios smaller than 2.5. From fluid dynamic principles, we know that the height of a disturbed flow zone is proportional to the frontal area of the building exposed to the wind, and that the disturbance extends to greater heights as the width of the building transverse to the wind increases. The 2.5 factor actually corresponds quite well to the theoretical height of a disturbance above a two-dimensional fence in potential flow, and this agrees with Dr. Brunt's observations over ridges.

Accordingly, to apply the rule correctly we should look for the projection of the building above a surrounding effective ground, and note whether the building is essentially two- or three-dimensional. In Fig. 3a, the flow approaching the power plant is broken by several small buildings, and it straightens out above the roof of the garage at el 105 ft. If this height is taken at the effective ground, the ratio would be (352-105)/(177-105) =3.43. Alternatively, the effective ground could be lowered to 60 ft before the ratio drops below 2.5. The use of an effective ground at the 37 ft grade is not warranted by flow considerations. Thus, the height ratio should give no cause for concern, particularly since the building is more three-dimensional than two-dimensional, and therefore creates a smaller disturbance.

Finally, Comment 3 refers to "my idea to keep the stack exit velocity at or above 55 fps from the stack". I cannot trace this figure, although I recommended in my 1975 report that an emission velocity of 60 fps be maintained to prevent stack downwash. The term stack downwash refers in this context to local descent of the plume below the top of the stack when the wind velocity exceeds the emission velocity. A high emission velocity will allow the plume

to break free of the stack at high wind speeds. The present stack design calls for lower emission velocities for reasons that outweigh the disadvantages of local downwash. In any case, the effect of this downwash has been included in the plume rise calculation in the current analysis in a conservative manner, i. e., by assuming that the local plume descent is effective along the entire length of the plume.

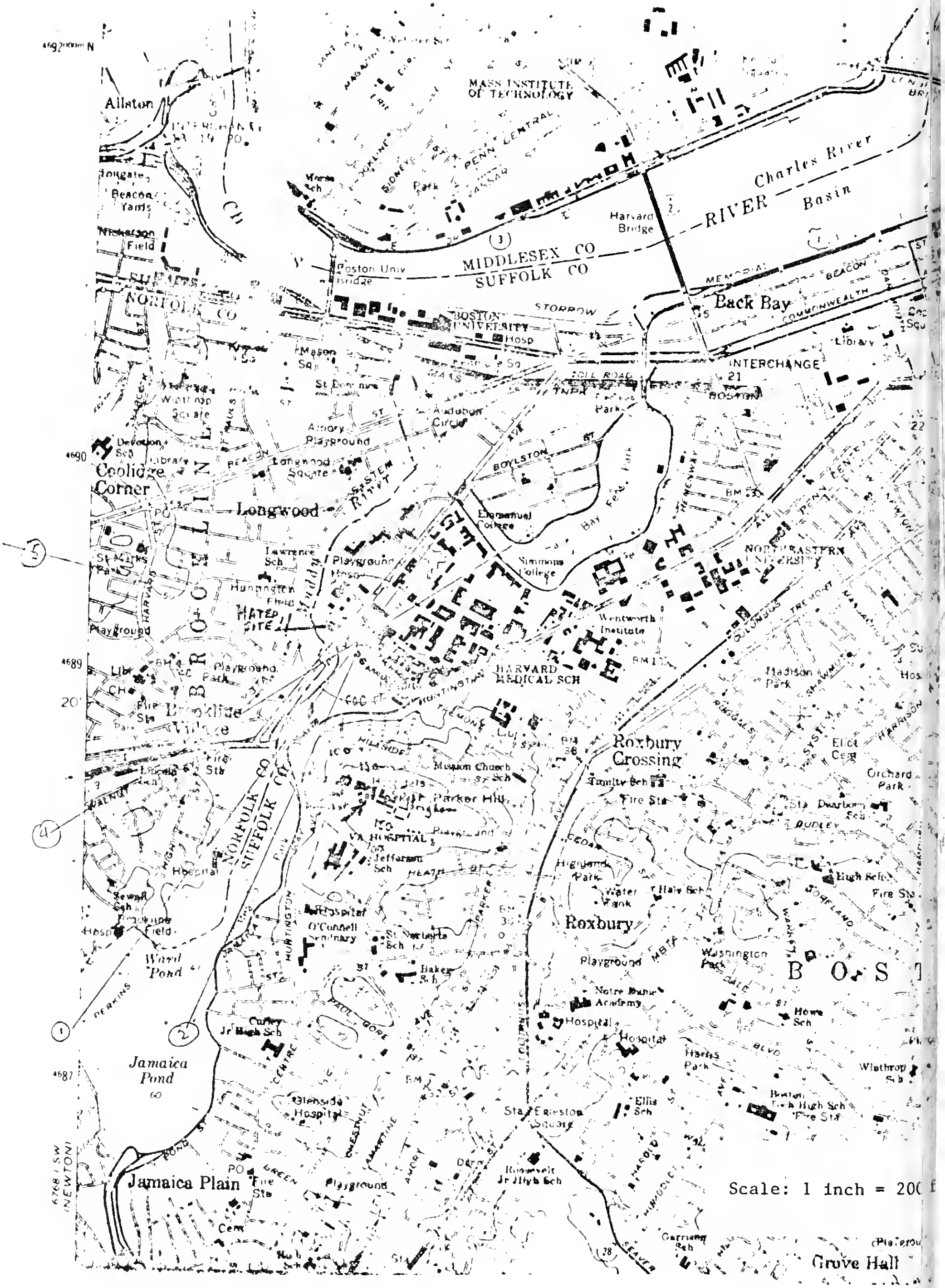
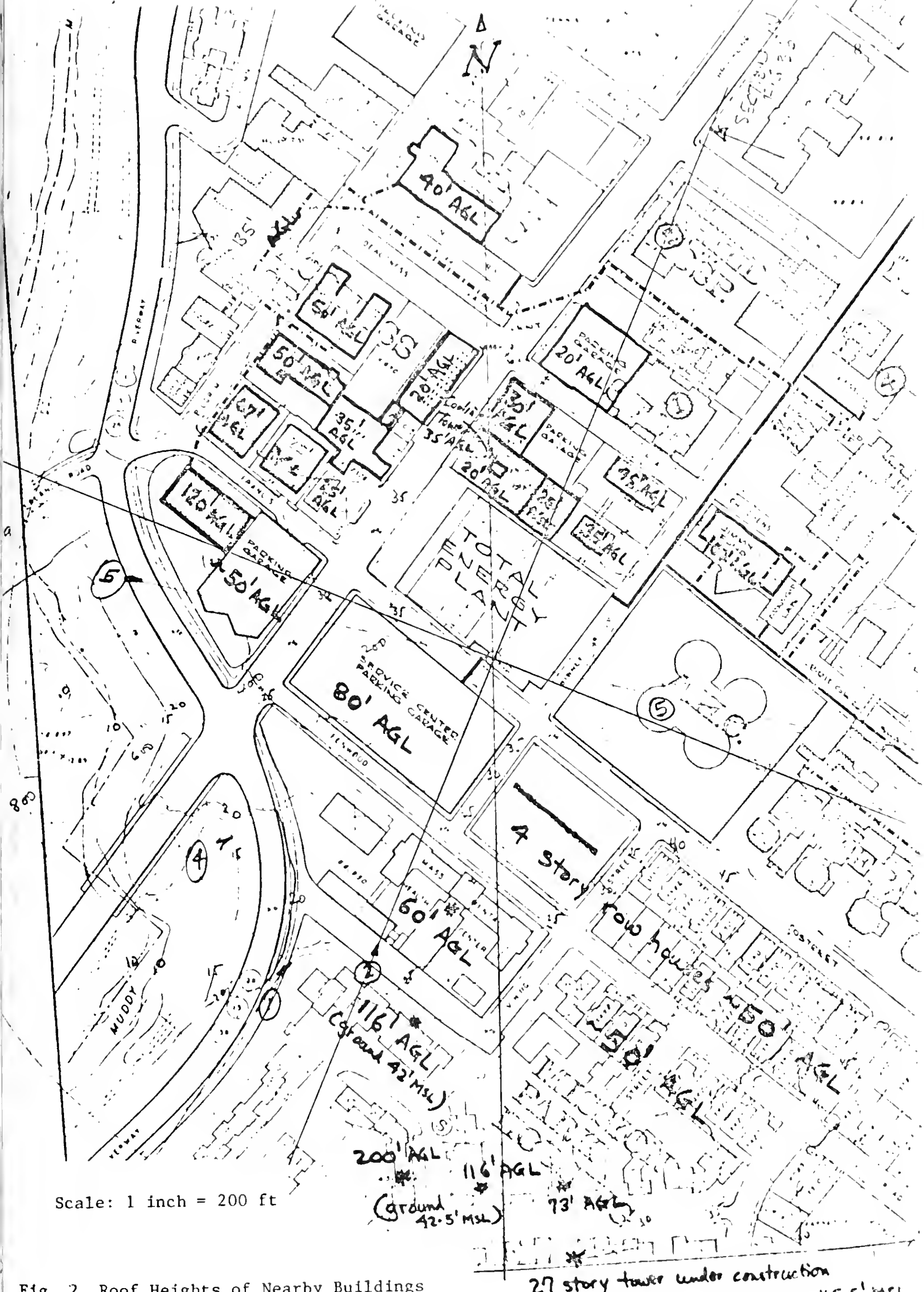
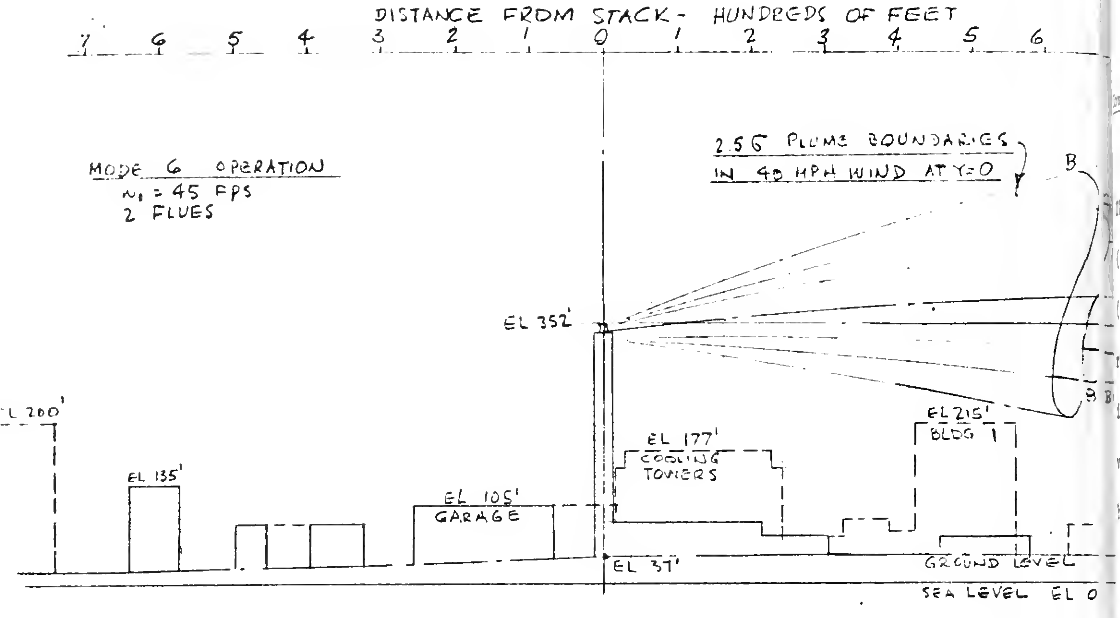


Fig. 1 Topographical Map of MATEP Site

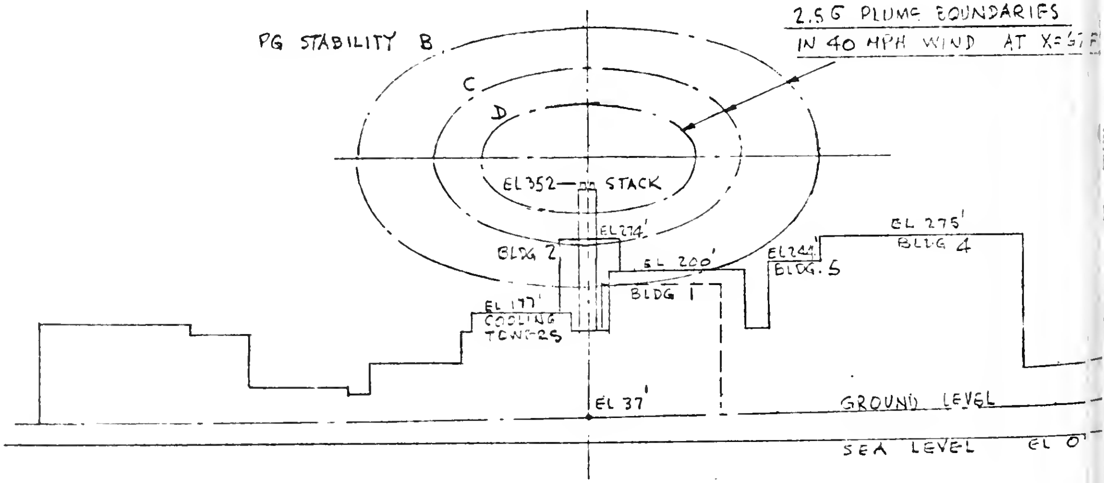


Scale: 1 inch = 200 ft

Fig. 2 Roof Heights of Nearby Buildings



a) Vertical section through stack and Bldg. 2, looking westerly



b) Elevation view looking northerly from stack to Bldg. 2

Fig. 3 Building, Stack and Plume Configurations in Mode 6 Operation in a 40 mph Wind

Scale: 1 inch = 200 ft

BROOKLINE SELECTMEN'S AD HOC COMMITTEE ON THE HARVARD ENERGY PLANT

March 7, 1977

Comment 2

Substantial Changes From The EIR

1. The height of the building from grade to the top of cooling tower array (covering over half the actual building top) has increased from 98 ft. (EIR Fig. 3.5.2) to 152 ft. (AQ Plans Fig. 3.8). This change not only results in a greatly increased visual impact but also substantially increases the chances of downwash from the stack in the immediate vicinity of the power plant building. Stack height to building ratio has gone from 3 to 2, thus falling well into a regime of concern (2.5).

BROOKLINE SELECTMEN'S AD HOC COMMITTEE ON THE HARVARD ENERGY PLANT

March 7, 1977

Comment 1

Outline of Position on the MATEP Application for Approval of Air Quality Plans

. Pollution effects. Local temporary concentration of pollutants are of concern for all the major pollutants, under certain meteorological conditions.

1. J. Spengler has shown that three-hour averages for SO_2 are capable of being violated on the Prudential tower and can be much more substantial on Parker Hill than indicated in the Plans.

2. "Downwash" or high concentrations appear to be of serious concern for any of the eight wind directions connected to the four nearby buildings that are 200 feet or over in height.

February 8, 1977

Comment 3

Questions about the MATEP Application for Approval of Air Quality Plans

What happened to Halitsky's idea to keep the exit velocity at or above 55 fps from the stack? His analyses of the EIR were based on this assumption, yet the MATEP Application to DEQE for Air Quality Plans Approval permits stack velocities of 40 fps and less.

Calculation of Concentrations at Nearby Building Roofs
Resulting from Stack Emissions from the
Proposed Masco-Harvard Power Plant

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January 10, 1977

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1. Introduction

In a previous analysis (Ref. 1) it was concluded that the proposed a:o-Harvard stack and nearby tall buildings were sufficiently far apart to low the use of isolated stack dispersion models to calculate concentrations tthe building surfaces. It was also concluded that the stack plume would ie sufficiently high over the roofs of the tallest buildings to produce only nignificant concentrations at the building roofs.

In this report, concentrations are calculated at the roofs of Buildings 1,2, 4 and 5, using new stack loading conditions and physical dimensions. The alysis assumes direct impingement of the plume on the buildings, with no credit taen for reduction of concentration due to displacement of wind flow around th building or mixing in the building wake.

2. Physical Configuration

Figs. 1-4 show the local topography, the heights of various tall buildings nar the plant, a plan view of the four tallest buildings in relation to the pint stack, and a sketch of the principal stack dimensions.

The topography is essentially flat in the vicinity of the plant, with gound elevation = 37 ft at the stack. The highest ground elevation within several mles of the plant is Parker Hill (elev. 200 ft), located about 2600 ft to the sth. Inasmuch as this 200 - 37 = 163 ft rise of ground is only about 6% of te distance between Parker Hill and the plant, it may be assumed that the efect of the hill on airflow at the plant is unimportant for the present analysis.

The tallest buildings are Nos. 1, 2, 4 and 5, with roof elevations ranging fom 180 ft to 240 ft. Table 1 summarizes the important dimensions of the bilding roofs with respect to the base of the stack. Note that values of h, roof height above stack grade, were calculated by subtracting an assumed sack grade elevation of 35 ft, rather than the actual grade of 37 ft. This

assumption, carried over from the previous report (Ref. 1), effectively results in a calculation of concentration at an elevation 2 ft above each roof, rather than at roof elevation. Since the plumes lie above the buildings at all wind speeds, concentrations increase with height above the roof; therefore actual roof level concentrations will be somewhat less than those calculated in this report.

The power plant stack consists of two individual flues within a circular shell of O.D. 26 ft, with the flues projecting 10 ft above the top of the shell and terminating at an elevation of 352 ft or 315 ft above stack grade elevation of 37 ft. The distance between flue centerlines is 10.5 ft, and the line joining the centerlines is parallel to Francis St. When viewed along this line, each flue tapers in width from 11 ft at top of shell to 8 ft at top of stack. When viewed normal to the line of centerlines, each flue has a constant 8 ft width above the shell. The cross-section of each flue at the top of the stack is circular with I.D. = 8 ft. The flue wall is about 3.5 in. thick.

3. Operating Conditions

The power plant will operate with one flue when the total gas mass flow rate is less than about 500,000 lb/hr, and with two flues when the flow rate exceeds this value. Calculations were made for 11 postulated operating modes; these are listed in Table 2 with associated emission rates of suspended particulates, SO_2, NO_2 and sootblowing particulates.

4. Calculation of χ/Q at Building Roofs

Unit concentrations at building roof level were calculated by

$$\chi/Q = (2\pi\sigma_y\sigma_z u)^{-1} \exp\{-1/2\,(h_p - h_r)^2/\sigma_z^2\} \quad (1)$$

where

χ = concentration ($\mu g/m^3$) at point (x, y, z)

Q = particulate release rate ($\mu g/sec$) at (0, 0, h_s)

u = wind speed (m/s)

σ_y = lateral dispersion parameter (m)

σ_z = vertical dispersion parameter (m)

h_p = plume centerline height at distance x

h_r = building roof height at distance x

h_s = stack height at x = 0

ground reflection term was omitted in Eq. 1 because its contribution was zero the distances and heights under consideration.

Plume centerline heights were calculated by

$$h_p = h_s + \Delta h_p + \Delta h_d \quad (2)$$

ere

Δh_p = plume rise (m) at dist. x due to emission velocity and buoyancy

Δh_d = increment (negative) of plume rise (m) due to stack downwash at high wind speeds.

In Eq. 2, h_s was taken as 315 ft (96.0 m), and Δh_p and Δh_d were calculated the Briggs formulas given in Refs. 2, 3 and 4.

For one flue operation,

$$\Delta h_{p_1} = 1.6F^{1/3}u^{-1}x^{2/3} \quad (3)$$

ere

x = downwind distance (m)

F = buoyancy flux (m^4/sec^3) given by

$$F = gw_o r^2_o \ (1 - T/T_o) \quad (4)$$

ere

g = gravitational constant = 9.8 m/sec^2

w_o = emission velocity (m/s)

r_o = emission radius = 1.219 m (4 ft)

T = ambient temperature = 528R (assumed)

T_o = emission temperature = 760R (modes 1-10)

726R (mode 11)

For two-flue operation,

$$\Delta h_{p_N} = \Delta h_{p_1} \left(\frac{N + S}{1 + S}\right)^{1/3} \tag{5}$$

$$S = 6 \left\{\frac{(N - 1)s}{N^{1/3}\Delta h_{p_1}}\right\}^{3/2} \tag{6}$$

where

N = number of flues = 2

s = flue spacing = 3.20 m

(Note: Effective flue spacing s reduces as wind direction deviates from the normal to the line of flue centerlines. A smaller value of s yields a larger value of Δh_{p_N}. This effect has been neglected for conservatism.)

The stack downwash term Δh_d in Eq. 2 was calculated by

$$\begin{aligned} \Delta h_d &= 2\,(w_o/u - 1.5)\, d_o \quad (\text{for } w_o/u < 1.5) \\ &= 0 \qquad\qquad\qquad\qquad (\text{for } w_o/u \geq 1.5) \end{aligned} \tag{7}$$

where

d_o = emission diameter = 2.438 m (8 ft)

and the value of Δh_d was applied uniformly at all downwind distances.

Values of σ_y and σ_z were calculated by assuming initial dispersion of the jet plume according to the Halitsky model in Ref. 5, and subsequent dispersion by atmospheric turbulence alone after termination of the jet. The equations for σ_y and σ_z are:

two-flue operation:

$$\sigma_y = 0.4(1.6 \cos \beta + R_2) + a_y(x - x_2)^{p_y} \tag{8}$$

$$\sigma_z = 0.4R_2 + a_z(x - x_2)^{p_z} \tag{9}$$

one-flue operation:

$$\sigma_y = 0.4R_2 + a_y(x - x_2)^{p_y} \tag{8a}$$

$$\sigma_z = 0.4R_2 + a_z(x - x_2)^{p_z} \tag{9a}$$

ere

R_2 = radius of plume from single flue at end of jet region according to Fig 10 of Ref 5

x_2 = horizontal distance to end of jet region, derived graphically by plotting s_2 from Fig 10 of Ref 5 along plume centerline

β = angle between normal to line joining flue centerlines and line joining stack and building

= α - 31.5, with α from Table 1

a_y, p_y, a_z, p_z = stability-dependent turbulence parameters, found by fitting a power law of the form $\sigma = ax^p$ to the graphs in Figs 3-2 and 3-3 of Ref 6, using coordinate values at distances of 200 and 400 m. Table 3 gives numerical values of the constants.

The calculation of χ/Q by Eq 1 was made for five wind speed-stability class ombinations as follows:

Wind speed (mph):	5	10	20	40	70
Stability class:	A	B	C	D	D

he use of unstable, rather than stable, stability classes at each wind speed rovides large vertical expansion of the plumes, a condition that creates igher concentrations at roof level. The specific stability class chosen for ach wind speed represents the most unstable condition that may be expected at hat speed.

Fig 5 shows curves of χ/Q at the roofs of Bldgs 2 and 4 vs mission velocity w_o, for the speed-stability combinations listed above, for ne-flue operation. Fig 6 shows similar curves for two-flue operation. The ange of w_o in Figs 5 and 6 includes all the values of w_o in operating modes - 10, as cited in Table 2. The calculation was made at w_o = 9, 12, 15 and 18 m/s, corresponding to 29.5, 39.4, 49.2 and 59.1 ft/sec, respectively. The values of χ/Q in mode 11, boiler start-up, were about an order of magnitude higher than

for the other modes, and could not be plotted conveniently. Actual values are tabulated in Fig 5.

Values of χ/Q for Buildings 1 and 5 were too low for plotting. The maximum value in modes 1 - 10 was 0.010 sec/m^3 at Bldg 5 for one-flue operation at w_o = 29.5 ft/sec with u = 10 mph. For mode 11, the maximum value was 0.685 sec/m^3 at Bldg 5 with u = 10 mph. These buildings were not included in subsequent calculations since roof level concentrations were either zero or very low.

5. Calculation of χ at Building Roofs

Values of χ were calculated by multiplying the emission rate from Table 2 by the value of χ/Q from Fig 5 or Fig 6 at the appropriate wind speed, emission velocity, flue number and building number.

Table 4 lists the maximum and second maximum values of χ, together with the wind speeds at which they occur, in each of the operating modes. In modes 1 - 10, maxima occur at u = 70 mph (D stability). The probability of occurence of a 70 mph wind is very small. As the wind speed decreases, the concentration decreases very rapidly because the plume rides higher over the buildings, e.g., at a wind speed of 40 mph (D stability), the concentration is about an order of magnitude lower than at a wind speed of 70 mph (see Figs 5 and 6). Therefore the second maximum, at u = 20 mph, is a more realistic value.

In mode 11, the maximum χ occurs at u = 20 mph and the second maximum occurs at u = 10 mph. The two maxima have about the same value.

It should be noted that the calculated concentrations represent an averaging period of about 10 minutes (Ref 6). Longer averaging times produce smaller concentrations. This factor has not been incorporated into the calculations.

6. Comparison with Ambient Air Quality Standards

Table 5 shows the maximum calculated concentration at any building, and the related ambient air quality standard, grouped according to the averaging

ues in Table 2. The calculated concentrations are the first maxima (70 mph, stability) at Bldg 4, from Table 4. For the seasonal modes (1, 2, 3, 4), there is no 3-month standard, but the annual standard has been inserted in parenthesis for reference. There is no standard for the start-up mode (11).

All standards are seen to be met, even with the improbable first maximum condition, with no correction for averaging time in the calculations. The averaging time correction applied to seasonal averages would produce a considerable decrease in the calculated concentration. The reduction would not be as great for the 3-hr and 24-hr modes, and would depend upon the steadiness of the wind for the given period.

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2. Briggs, G.A. (1969): Plume Rise. U.S.A.E.C. Div. of Tech. Inf., CFSTI TID - 25075

3. Briggs, G.A. (1973): Diffusion Estimation for Small Emissions, NOAA Air Resources Atmos. Turb. and Diff. Lab Contributions File No. (Draft) 79.

4. Briggs, G.A. (1974): Plume Rise from Multiple Sources

5. Halitsky, J. (1966): A Method for Estimating Concentrations in Transverse Jet Plumes. Air and Water Poll. Int. J 5 10, pp 821-843

6. Turner, D.B. (1969): Workbook of Atmospheric Dispersion Estimates. EPA OAP Pub No. AP - 26

Table 1. Heights and Locations of Nearby Tall Buildings

Bldg. No.	Bldg. Name	Roof Elev. (ft)	(1) h_r Roof Ht. Above Stack Grade (ft)	(2) Direc. From Stack, α (deg)	(3) Dist. From Stack (ft)
	Dana (CCRF)	215	180	032	466
	Apt. (CHMC)	274	239	017	673
	Child. Res.	275	240	049	754
	AHC	244	209	098	413

Notes:

1) Assumed stack grade elevation = 35 ft

2) 000 = North

3) Measured to building centerline

Table 2. Operating Conditions

Mode	Name	No. of Flues	Flue Gas: Flow Rate (10^3)lb/hr	Flue Gas: Exit. Vel. ft/sec	Emissions (lb/hr) (Including Incinerators): Susp. Part.	SO_2	NO_2	Sootbl. Part.
1	Fall season (average)	1	477.5	50.3	10.45	127.6	552.3	11.73
2	Winter season (average)	2	583.2	30.7	8.06	198.7	499.6	10.06
3	Spring season (average)	1	493.6	52.0	10.29	136.8	552.4	11.55
4	Summer season (average)	1	520.7	54.9	13.58	130.1	653.3	13.58
5	Winter (max 24-hr)	2	744.2	39.2	8.53	288.7	519.8	12.85
6	Winter (max 3-hr)	2	855.4	45.0	11.50	332.5	621.4	17.85
7	Summer (max 24-hr)	2	702.7	37.0	12.42	170.0	844.8	12.42
8	Summer (max 3-hr)	2	838.8	44.2	16.90	224.1	1046.6	18.18
9	Annual (min 24-hr)	1	427.9	45.1	9.53	102.9	513.9	9.53
10	Annual (min 3-hr)	1	397.5	42.0	8.32	93.9	465.6	8.32
11	Boiler start-up	1	56.5	5.7	4.93	29.6	18.4	—

Flue gas temp. = 300F (modes 1 - 10), 266F (mode 11)

Flue gas density = .0755 lb/ft^3 at 68F

Table 3. Atmospheric Dispersion Parameters

	Stability Class			
	A	B	C	D
a_y	0.609	0.312	0.151	0.100
p_y	0.832	0.896	0.953	0.953
a_z	0.0340	0.1238	0.0901	0.0510
p_z	1.277	0.964	0.946	0.954

$$\sigma_y = a_y x^{p_y} \qquad \sigma_z = a_z x^{p_z}$$

Table 4 Concentration Maxima at Buildings 2 and 4

				Values of χ ($\mu g/m^3$) at building roof (10-min avg.)							
				Building 2				Building 4			
Mode	Flues	u_{mph}	Rank	Part.	SO_2	NO_2	Soot.	Part.	SO_2	NO_2	Soot.
1	1	70	max	0.8	9.9	42.8	0.9	1.3	15.8	68.5	1.5
		20	2nd max	0.5	5.9	25.4	0.5	0.7	8.4	36.5	0.8
2	2	70	max	0.9	22.0	55.4	1.1	1.4	33.4	84.0	1.7
		20	2nd max	0.3	6.4	16.1	0.3	0.4	10.3	25.9	0.5
3	1	70	max	0.8	10.1	40.7	0.9	1.2	16.2	65.6	1.4
		20	2nd max	0.4	5.9	24.0	0.5	0.7	8.7	35.1	0.7
4	1	70	max	0.9	8.8	44.0	0.9	1.5	14.4	72.2	1.5
		20	2nd max	0.6	5.3	26.5	0.6	0.8	7.8	39.1	0.8
5	2	70	max	0.7	23.3	41.9	1.0	1.1	36.9	66.5	1.6
		20	2nd max	0.2	5.7	10.2	0.3	0.3	8.8	15.8	0.4
6	2	70	max	0.8	22.2	41.5	1.2	1.2	35.4	66.2	1.9
		20	2nd max	0.2	5.4	10.2	0.3	0.3	8.4	15.7	0.4
7	2	70	max	1.1	14.6	72.4	1.1	1.7	23.2	115.5	1.7
		20	2nd max	0.3	3.6	18.1	0.3	0.4	5.8	28.6	0.4
8	2	70	max	1.2	15.5	72.3	1.3	1.8	24.4	114.1	2.0
		20	2nd max	0.3	3.7	17.4	0.3	0.4	5.8	26.9	0.5
9	1	70	max	0.9	9.3	46.6	0.9	1.3	14.5	72.5	1.3
		20	2nd max	0.5	5.4	27.1	0.5	0.7	7.8	38.9	0.7
10	1	70	max	0.8	9.3	46.2	0.8	1.3	14.4	71.6	1.3
		20	2nd max	0.5	5.4	26.7	0.5	0.7	7.6	37.5	0.7
11	1	20	max	4.5	26.8	16.7	-	4.9	29.4	18.3	-
		10	2nd max	4.4	26.3	16.3	-	4.5	27.2	16.9	-

Table 5 Comparison of Calculated Concentrations with Massachusetts Ambient Air Quality Standards

le	Name		Concentration χ (μg/m^3) Part.	SO_2	NO_2	Sootbl.
,3,4	Seasonal	calc. 1st max	1.5	33.4	84.0	1.7
		calc. 2nd max	0.8	10.3	39.1	0.8
		annual std*	(75)	(80)	(100)	(75)
,9	24-hr	calc. 1st max	1.7	36.9	115.5	1.7
		calc. 2nd max	0.7	8.8	38.9	0.7
		24-hr std*	(260)	(365)	-	(260)
,10	3-hr	calc. 1st max	1.8	35.4	114.1	2.0
		calc. 2nd max	0.7	8.4	37.5	0.7
		3-hr std**	-	(1300)	-	-
	Start-up	calc. 1st max	4.9	29.4	18.3	-
		calc. 2nd max	4.5	27.2	16.9	-

primary standard

secondary standard

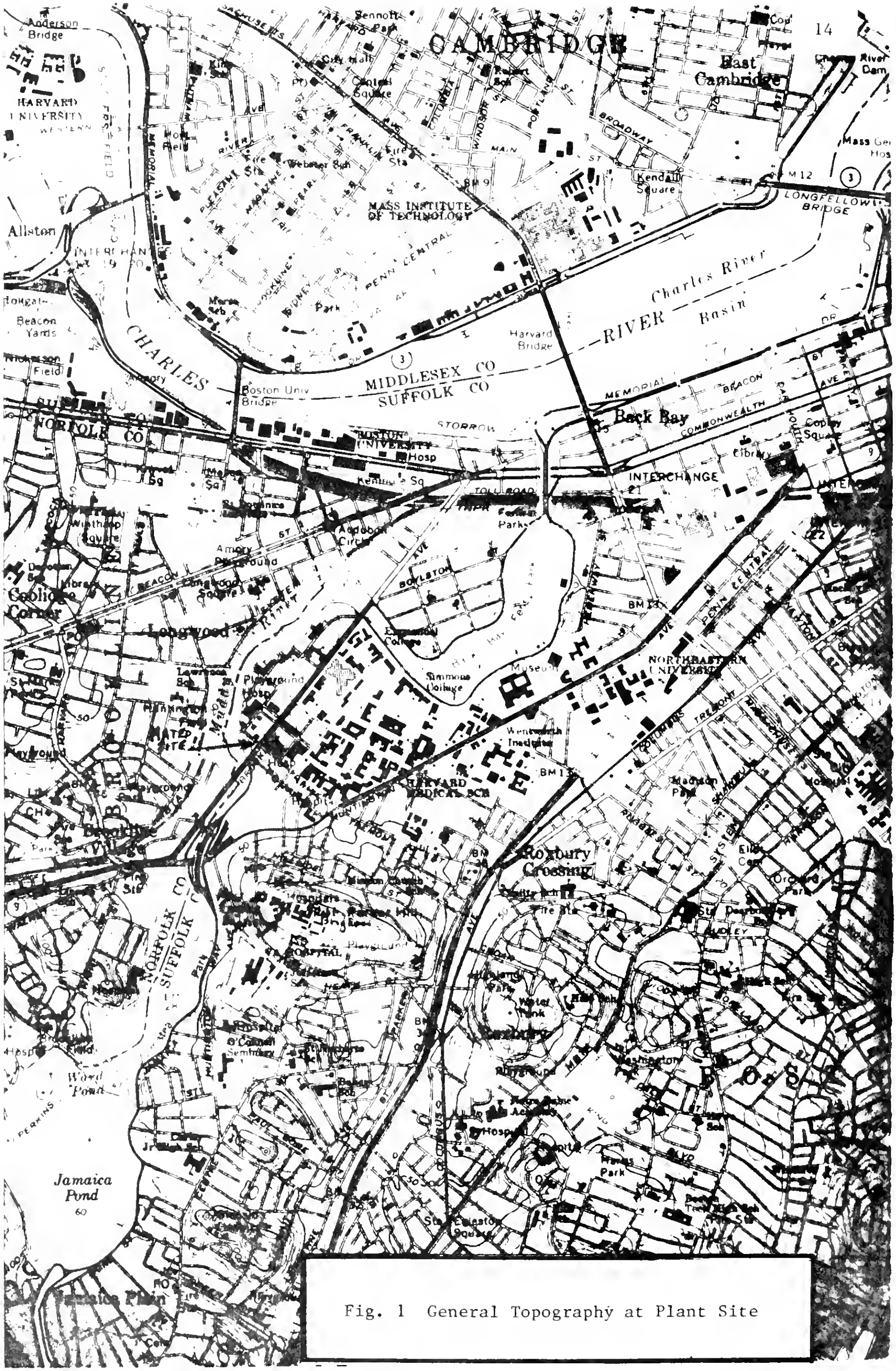

Fig. 1 General Topography at Plant Site

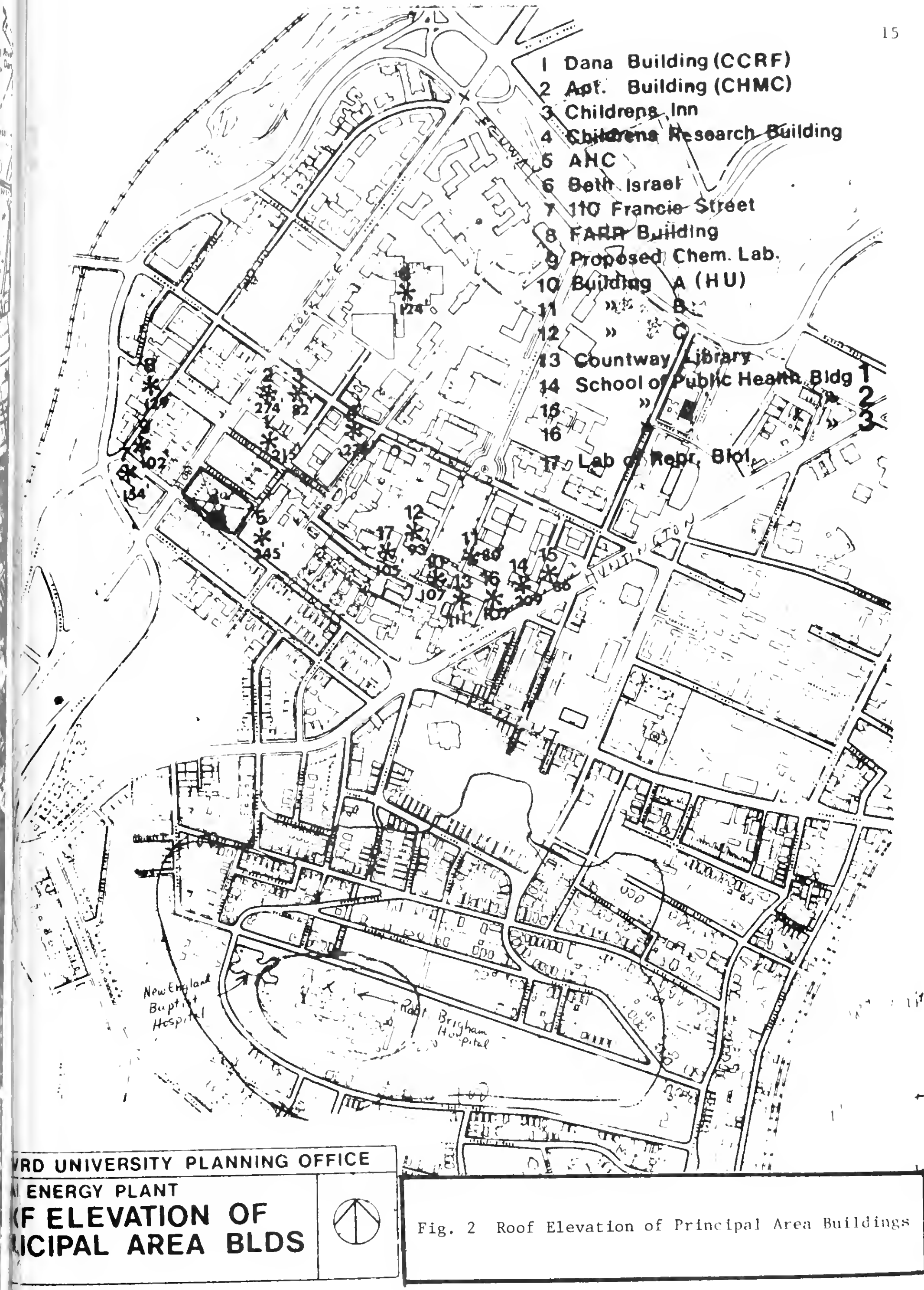

Fig. 2 Roof Elevation of Principal Area Buildings

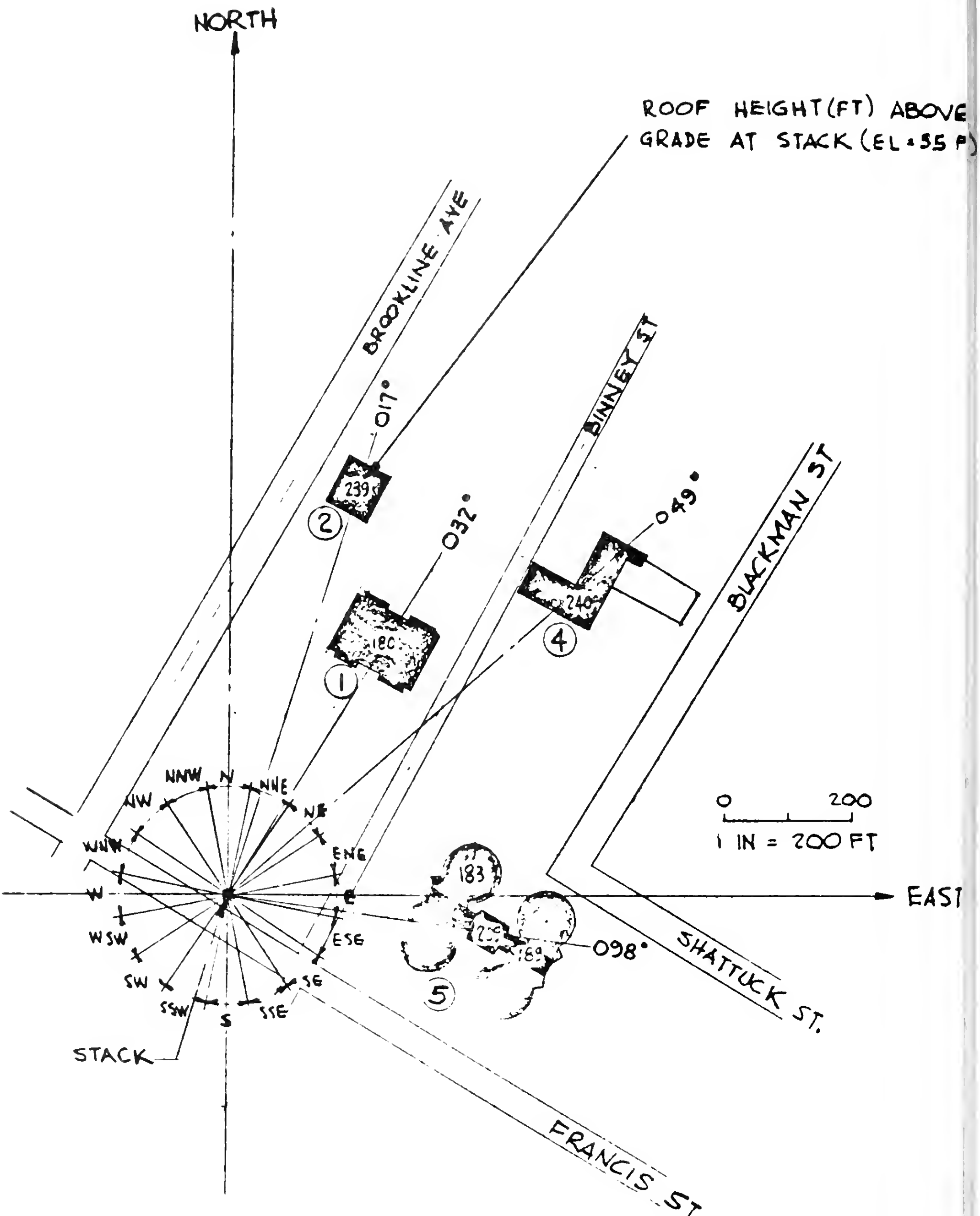

Fig. 3 Building Arrangement

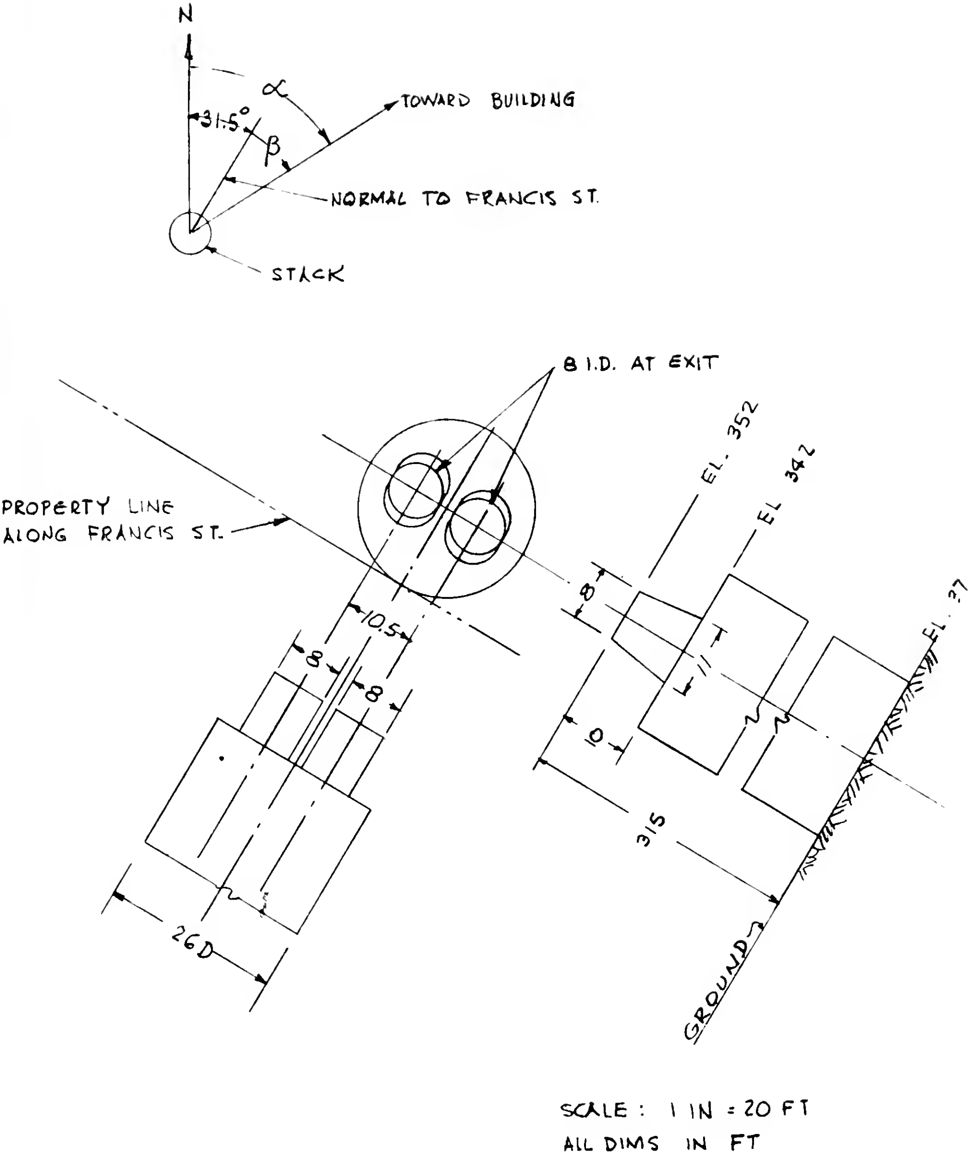

Fig. 4 Stack Dimensions

Fig. 5 χ/Q at Roof Elevation at Bldgs. 2 and 4
Stack Operation with One Flue

Values of 10^6 χ/Q for w_o = 1.74 m/sec (mode 11)

u (mph)	10^6 χ/Q at Bldg. 2	10^6 χ/Q at Bldg. 4
5	4.32	5.08
10	7.04	7.30
20	7.19	7.89
40	2.77	3.85
70	3.18	4.05

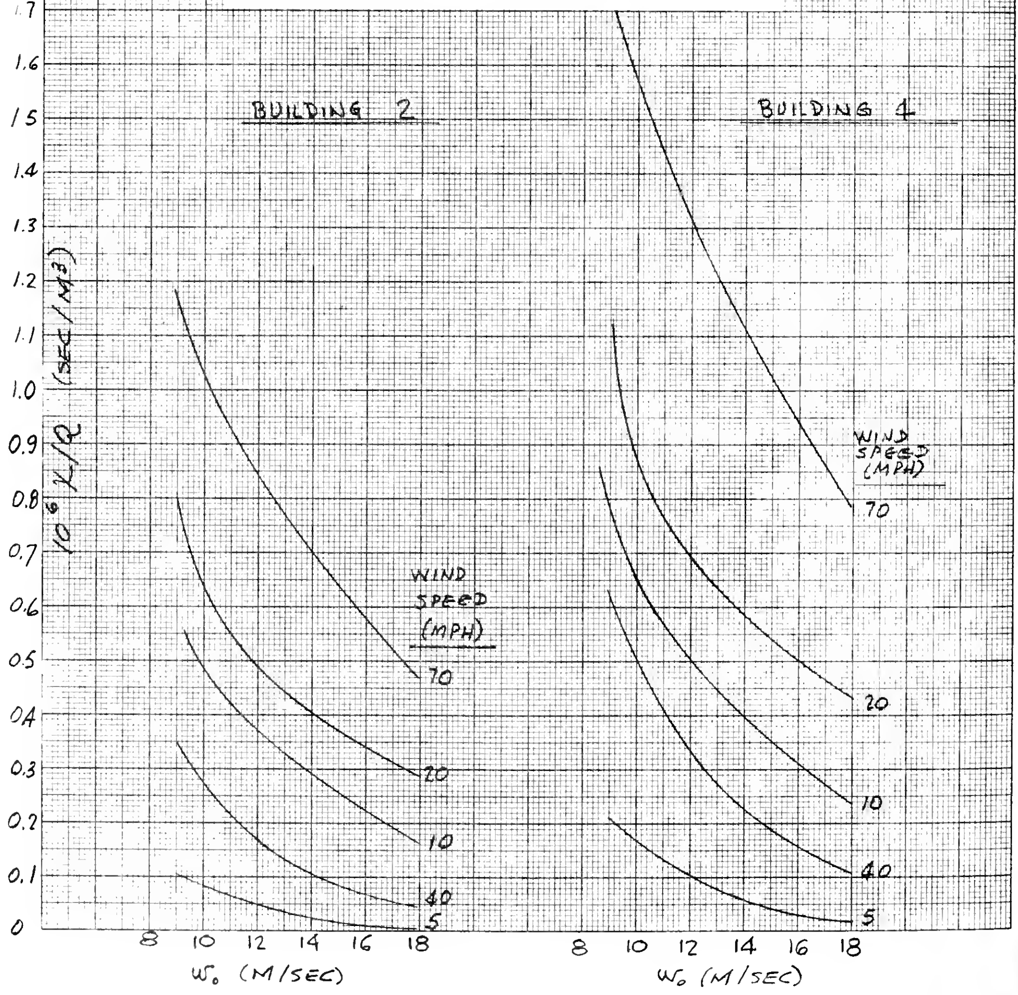

Fig. 6 χ/Q at Roof Elevation of Bldgs. 2 and 4

Stack Operation with Two Flues